1986 SCIENCE AND TECHNOLOGY POSTURE HEARING WITH THE DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

HEARING

BEFORE THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

SECOND SESSION

FEBRUARY 6, 1986

[No. 151]

Printed for the use of the
Committee on Science and Technology

U.S. GOVERNMENT PRINTING OFFICE

60-006 O WASHINGTON : 1987

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

H701-22

COMMITTEE ON SCIENCE AND TECHNOLOGY

DON FUQUA, Florida, *Chairman*

ROBERT A. ROE, New Jersey
GEORGE E. BROWN, JR., California
JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
TIMOTHY E. WIRTH, Colorado
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
ROBERT A. YOUNG, Missouri
HAROLD L. VOLKMER, Missouri
BILL NELSON, Florida
STAN LUNDINE, New York
RALPH M. HALL, Texas
DAVE McCURDY, Oklahoma
NORMAN Y. MINETA, California
MICHAEL A. ANDREWS, Texas
BUDDY MacKAY, Florida **
TIM VALENTINE, North Carolina
HARRY REID, Nevada
ROBERT G. TORRICELLI, New Jersey
RICK BOUCHER, Virginia
TERRY BRUCE, Illinois
RICHARD H. STALLINGS, Idaho
BART GORDON, Tennessee
JAMES A. TRAFICANT, JR., Ohio

MANUEL LUJAN, JR., New Mexico *
ROBERT S. WALKER, Pennsylvania
F. JAMES SENSENBRENNER, JR., Wisconsin
CLAUDINE SCHNEIDER, Rhode Island
SHERWOOD L. BOEHLERT, New York
TOM LEWIS, Florida
DON RITTER, Pennsylvania
SID W. MORRISON, Washington
RON PACKARD, California
JAN MEYERS, Kansas
ROBERT C. SMITH, New Hampshire
PAUL B. HENRY, Michigan
HARRIS W. FAWELL, Illinois
WILLIAM W. COBEY, JR., North Carolina
JOE BARTON, Texas
D. FRENCH SLAUGHTER, JR., Virginia
DAVID S. MONSON, Utah

HAROLD P. HANSON, *Executive Director*
ROBERT C. KETCHAM, *General Counsel*
REGINA A. DAVIS, *Chief Clerk*
JOYCE GROSS FREIWALD, *Republican Staff Director*

---

*Ranking Republican Member.
**Serving on Committee on the Budget for 99th Congress.

CONTENTS

WITNESS

Page

February 6, 1986:
Dr. John P. McTague, Acting Science and Technology Advisor to the President and Acting Director, Office of Science and Technology Policy . 4

1986 SCIENCE AND TECHNOLOGY POSTURE HEARING WITH THE DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

THURSDAY, FEBRUARY 6, 1986

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The committee met, pursuant to call, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the committee) presiding.

The CHAIRMAN. Good morning.

Today the Science and Technology Committee initiates an intensive series of hearings on the President's budget proposals for the fiscal year 1987. As in years past, we begin that series with a posture hearing in which we expect to review the overall budget proposals for science and technology and the policies for Federal support for research and development on which the budget is based.

Our first witness is Dr. John McTague who is currently serving as Acting Director of the Office of Science and Technology Policy in the White House. Also as Director of OSTP, he is the Science and Technology Adviser to the President.

The Federal budget for these activities are under very serious stress, both in terms of the long-term factors and the more immediate concerns which contribute to that stress.

In the long term, there is probably an urgent need to reduce the deficit in the Federal Government, and that has been mandated by the Gramm-Rudman-Hollings Act.

Research and development is not one of those programs, such as Social Security, defense, or veterans benefits, which are exempt from the Gramm-Rudman-Hollings, and as such, science and technology has already experienced some modest cuts in fiscal 1986.

For fiscal 1987, it is, therefore, particularly welcome to find that the President's budget includes some notable increases in some areas of basic and applied research.

Many of us believe the resulting increase in the strength of our national capabilities in research and development will ensure that we will be able to deal with the equally important, long-term problems of productivity, international competitiveness, and the balance of trade.

However, in the shorter term, the budget is also under stress as the result of more immediate factors. Overshadowing most of our

concerns is last week's tragic disaster for the space shuttle and its crew of seven.

We welcome the President's support for the urgent need to find and resolve the technical problems which caused the accident. We also share his commitment to seek the earliest possible resumption of a shuttle flight schedule that has already yielded 24 outstandingly successful flights.

We welcome the continued commitment to the development of the space station which is a fine example of international cooperation in the field of large, costly R&D facilities.

Another large project, the Superconducting Supercollider, should also be examined from the point of view of international cooperation. We note that no major budget request for the SSC is included in the budget to initiate construction at this time. We will want to work with the Secretary of Energy and the OSTP Director to determine the feasibility of its funding, as well as its priority in comparison with other research facilities.

In the field of small science, the budget would provide modest to significant increases depending on the agency and program involved.

The recent Packard-Bromley report has emphasized the importance of our university system for both basic research and for the training of new generations of scientists. We will want to examine the budget proposals for these activities with great care.

All of these topics, as well as many others, are on the agenda for today's hearing. We look forward to Dr. McTague's testimony and we will have some discussion following that.

I also understand that you have a time problem this morning of another meeting that has come up. We will certainly try to accommodate that.

Mr. Boehlert.

Mr. BOEHLERT. Mr. Chairman, I want to thank you, it is a pleasure to be here this morning because I know we are going to be hearing some good news in a time when we have had too much bad news lately.

The President's fiscal 1987 budget recognizes the central role science plays in securing our economic future. The healthy increases proposed for the National Science Foundation, for example, signal not only continuing support for basic research but also an equally vital commitment to science education. The budget makes a particular effort to remedy specific deficiencies in our research programs such as the inadequate quantity and quality of instrumentation. That is the good news.

The bad news is that in an era of shrinking budgets, we may not be able to sustain these increases. We are going to try but we have got our work cut out for us. I think that in setting our priorities, we must start with the premise that scientific funding is an indispensable investment in our Nation's future. With that in mind, we should strive, at the very least, to maintain the science budget at its current level. But let me stress again, I applaud the President for his initiative, his leadership, his direction, in asking of the Congress of the United States more money in this vital area, because we are talking about international competitiveness in the 21st century.

I would remind Dr. McTague that to a large extent, today he is preaching to the converted—we are already with you.

I didn't hear too many of our colleagues react to the new budget yesterday with professions of faith in the value of science. Everyone in the scientific community is going to have to work together if science funding is to remain at adequate levels—that means Congressmen and Senators—all Congressmen and all Senators—should be hearing over the next few weeks from researchers and university administrators, and trustees, and everyone across this country of ours that is concerned about this very important activity of the Federal Government.

I am reminded of just a few weeks ago an interesting little setting I had with all the deans of the various colleges at Cornell University, which is near and dear to my heart. They sat around saying to me, we would like you to support the chairman's bill on facilities. They said, now, we have got this massive plan under way, we are going to lobby Chairman Fuqua, and we are going to get to the ranking member, Mr. Lujan, and we are working on you today, we want to get you to support this.

I said, wait a minute, fellows, you are misdirecting your activities. The chairman is the author of the bill, obviously, he is for it. The ranking minority member is a cosponsor, as am I—we are for it. What you have got to do is go across this country and get your colleagues who have members that don't know the first thing about scientific policy and what this important committee is doing, and get them lobbied. So I hope that message got across to them. I think it is very important.

The people who would benefit in the short run from this budget must be out there explaining how all of us will benefit in the long run from it, and we do benefit. Anyone who doubts that need look only at how eager our adversaries and competitors in the international marketplace are to get their hands on our research results.

But the argument for science was put in its purest and most eloquent form centuries ago—where there is no vision, the people perish. I am glad to be here today, and I am glad to welcome Dr. McTague, and I am glad to tell him right from the outset something that not many members are telling many administration representatives—I am with you 100 percent.

I know, Mr. Chairman, that our ranking member, Mr. Lujan, will be here shortly. He does have a statement that I would ask permission be inserted in the record at this point.

The FUQUA. Without objection, it will be made part of the record.

[The prepared opening statement of Mr. Lujan follows:]

STATEMENT OF THE HONORABLE MANUEL LUJAN, JR.

Mr. Chairman, as we begin the fiscal 1987 budget debate, this Committee finds itself in an exceedingly uncomfortable position. We are between a rock and a hard place.

The "rock" is the amply documented need for increased science spending—a need the President's budget has quite properly recognized. The "hard place" is the equally well documented need to slash the budget deficit. It is no exaggeration to suggest that the future of the American economy will be determined by how skillfully we maneuver between those two requirements.

Our economy is driven by technology. Study after study has concluded that our technological lead is virtually the nation's sole advantage in the international marketplace.

The critical lead is a direct result of the resources we have committed to basic and applied research—to our universities, to our national laboratories, to agencies such as NASA. That lead is being challenged as never before, and our funding has not kept pace with that challenge. We desparately need new facilities, new instrumentation and new scientists.

I think that's a point the Membes of the Committee must bring home to our colleagues. Basic science research is not some sort of expensive hobby. It's a vital investment in our economic future.

But we have to admit that it's not the sole determinant of that future. The exorbitant value of the dollar—a result of the deficit—also hobbles us in the international marketplace.

It's not going to be easy to choose among competing priorities as we reduce overall government spending.

This Committee and the Administration must continue to be tireless advocates for the sciences if research is to avoid getting trampled in the rush to pare the deficit.

I am hopeful that Congress will pass a budget that at least maintains the current level of funding for sciences. But, that will only happen if we are as deliberate, as methodical, as dedicated in our efforts as the scientists we are helping support are in theirs.

Thank you.

Mr. FUQUA. Dr. McTague, we would be pleased to hear from you.

STATEMENT OF HON. JOHN P. McTAGUE, ACTING SCIENCE AND TECHNOLOGY ADVISER TO THE PRESIDENT AND ACTING DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT

Dr. MCTAGUE. Mr. Chairman, members of the committee, it is a pleasure to appear before you as the committee begins its deliberations on the Federal Government's course in research and development for fiscal year 1987. We are all aware that this is a watershed year for fundamental changes which will affect all segments of our Nation for many years to come.

Last year the Congress and the President set the stage with the enactment of the Gramm-Rudman-Hollings Act. This enforces a discipline for building one leg of the stool for the long-term strength and prosperity of our country.

Simply stated, Gramm-Rudman-Hollings lays out a schedule to wean us from the addiction of signing our children's names to IOU's for our own pocket money. This withdrawal process begins in a few weeks.

Absence of crippling debt is necessary for strength and prosperity, but it is not sufficient. We must also have the military capability to deter any potential aggressor, and the technological and human resources to compete effectively in an increasingly international marketplace.

These are the two remaining legs that the President and the Congress are addressing, beginning this week. Yesterday, the President submitted to the Congress his proposed budget for fiscal year 1987, which sets the priorities for all three legs. It meets the Gramm-Rudman-Hollings target for deficit reduction to $144 billion. This places a severe constraint on the discretionary component of the budget, which itself is only about one-fifth of the total Federal budget. That means that, in fiscal year 1987 and beyond, the Federal Government can fund only those activities that are necessary for it to fund, not those which are merely good and worthy.

The President has honored his 1985 agreement with the Congress for 3-percent real growth in the defense budget for fiscal 1987. This allows for continued modernization of our tactical and strategic forces, within a funding level which is still one-third smaller, as a fraction of GNP, than it was in 1960.

The President has also renewed his commitment to research as the third leg, assuring investment in the future. Just 2 weeks ago he stated, and I quote: "Continuing strong support for our Nation's science and technology has been and will continue to be a policy of this administration. The goals of this support are enhanced national security, improved quality of life, and increased international competitiveness. Today, more than ever before, we must use our technological resources aggressively in order to retain international leadership."

The proposed fiscal year 1987 R&D budget gets us back on an even keel from the formula cuts of fiscal 1986, partially restoring the trend of real growth experienced in the first half of the 1980's. Because of the long-term nature of research and science and engineering training, and the fragility of research teams, steady, predictable funding is especially important for optimizing future returns on our R&D investment.

From 1985 to 1987, basic research obligations are proposed to rise at an annual rate of 1.7 percent in real terms, or approximately one-third of the growth rate experienced in the first half of this decade.

If there is a single characteristic which epitomizes America, it is how we embrace change and pioneering as a way of life. Our parents and grandparents came here to change their lives, and thousands upon thousands still come every day. The Edisons, Wrights and Fords of an earlier generation used their individual inventiveness to make a reality out of the seemingly impossible, and created whole new classes of industries which underlie the Nation's strength, prosperity, and quality of life.

In the second half of the 20th century, we more consciously invested in new technology as the output from a continuum of new scientific knowledge and new engineering approaches. The results included military and commercial jet aircraft, lasers, computers, and the enormous field of microelectronics. We strongly benefited from basic research, especially that carried out at our universities, and from the scientists and engineers trained there in a forward-looking research environment.

These lessons have not been lost on the other nations of the industrialized and industrializing world. They too have learned how to systematize technological innovation, and have narrowed dramatically the technological leadership gap.

Universally, an increasing fraction of GNP is being invested on research and development, with Japan showing the most dramatic acceleration, as well as showing an increasing concern for basic research, the area in which the United States has clearly predominated for many decades.

Unless we respond effectively to this challenge, we face a certain loss of technological and economic leadership in the world, with consequences that are not measured in dollars alone. In short, we need a new national science and technology strategy as we begin to

approach the 21st century. Fortunately, we already have the seeds of that strategy planted across our country. And it does not require a massive infusion of increased Federal funding, but rather more effective use of what we have, together with the reasonable, steady increases the President has proposed.

The rapid emergence of modern biotechnology industries in the United States provides a lesson worth studying. Here, enlightened Federal support of multidisciplinary basic research in molecular biology, both in universities and Federal laboratories, led to the revolutionary technology of gene splicing. Close, two-way coupling between university researchers and commercial entities fostered rapid transfer of the genetic technology to engineering of specific products and is creating a whole new, albeit infant, industry in which we have a world lead.

This example teaches several lessons. One is that the most effective Federal role is not to attempt to drive specific commercial technologies, but to support forefront basic research, which will have payoffs not foreseeable at the time of funding.

The second is that multidisciplinary efforts can be exceptionally effective in advancing our knowledge.

The third is that person-to-person university/industry research relationships can benefit both partners without compromising the academic environment we so cherish.

Modest redirections of our Federal R&D investment to encourage these trends, without perturbing the predominately disciplinary structure of our universities, could have high payoff for our Nation, so that it will continue to lead the world in creating the next generation of new industries, whatever they may be.

A principal observation of the President's Commission on Industrial Competitiveness, still instructive a year after the publication of its report, was the value of encouraging stronger ties between government, universities, and industry, suggesting that their traditional aloofness was not in the best interest of the Nation. The transition from basic science to technology to product is occurring more and more rapidly, and will continue to accelerate in the future.

Moreover, it is not a one-way street. Science benefits from technology and its products in comparable measure. Thus, closer relationships more in the spirit of a partnership could be mutually—and nationally—beneficial.

Typically, Government bears the responsibility for funding research where a marketable return on the investment is neither guaranteed nor immediately obvious. Industry supports and conducts research with greater potential for short-term payoff. The university balances in the middle, as the locus of most of our basic research and the supplier of the highly trained talent which ultimately goes to work for industry.

The logic of this configuration does not preclude refinements, particularly when our Nation's competitive posture in the international marketplace is at stake.

For this reason we are aggressively pursuing an initiative to establish university-based, multidisciplinary, problem-focused, science and technology centers aimed at areas of broad national needs and relevant to industrial technology.

The working model for this sort of arrangement is the National Science Foundation's eminently successful engineering research centers program, begun in 1985 following an overwhelming response from the academic community. There are now six such centers addressing a wide variety of generic research areas including robotics, biotechnology, composite materials manufacturing, and intelligent manufacturing systems.

More importantly, the funding agreement stipulated that participating universities and industries collaborate in defining the areas of research to pursue, based on mutual interests. In addition to amassing the forces of industrial and academic scientists to solve technological questions with economic implications, these centers coincidentally provide a highly stimulating research and learning environment—a training ground of unparalleled opportunity for graduate and undergraduate students alike.

NSF plans to add more engineering research centers during the current fiscal year, and the fiscal year 1987 budget request contains plans for the operation of a total of about 15. This is a good beginning, but only a beginning.

This concept deserves emulation across the broad spectrum of interdisciplinary science, mathematics, and engineering. Indeed, the Department of Defense has already begun efforts in this direction through its university research initiative.

Notably, multidisciplinary, problem-oriented science and technology centers established cooperatively by university and industry on campuses are among the foremost recommendations of the White House Science Council's Panel on the Health of U.S. Colleges and Universities, whose report is due out shortly. Chaired jointly by a leader in high-technology industry, David Packard, and a preeminent university physicist, D. Allan Bromley, this panel urgently stressed the need to enable our colleges and universities to grow commensurate with society's growing demand for the new knowledge and new talent which is their product.

This calls for an increased Federal investment in higher education and for special attention to the maintenance of modern research facilities and instrumentation on our Nation's campuses—a call we intend to heed.

The charts that you have copies of and which are displayed to your left illustrate the general trends of our funding for research and development through the past decade and our projected trends through 1987.

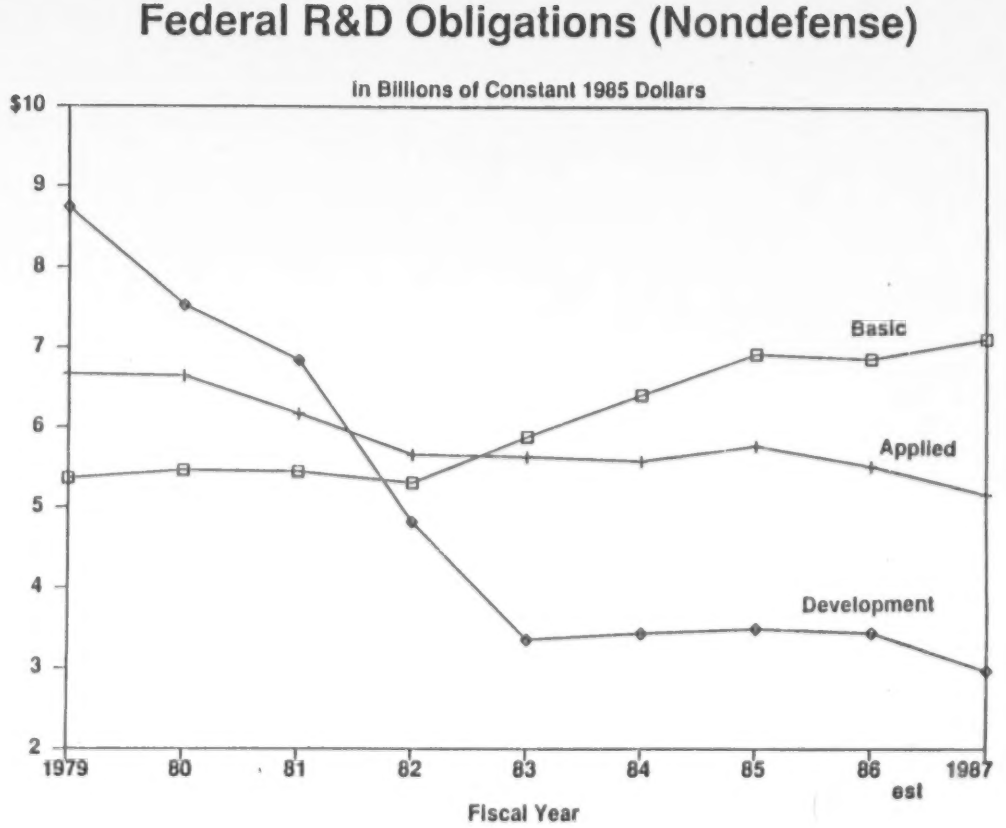

Federal R&D Obligations (Nondefense)
in Billions of Constant 1985 Dollars
$10
9
8
7
6
5
4
3
2
Basic
Applied
Development
1979
80
81
82
83
84
85
86
1987
est
Fiscal Year

CHART 1

Dr. McTAGUE. These charts are in constant 1985 dollars to take out inflation—and I hope in a few years we won't even have to do that.

The charts show the continuation of the trends of the past several years. We have a modest increase in real support for basic research over fiscal year 1985. We continue to decrease our emphasis on development activities that are more appropriate for the private sector, and applied research is slightly down. The net result is a continued emphasis on the role, which is a unique responsibility of the Federal Government, namely, basic research.

Could I have the next chart, please?

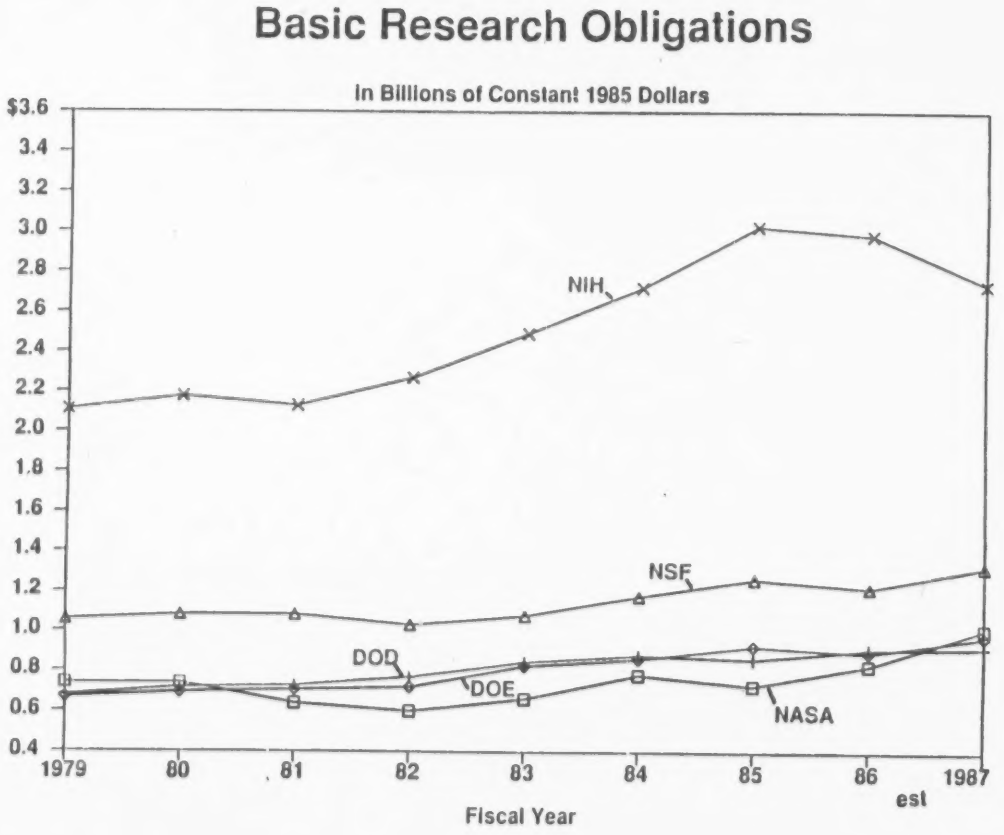

Basic Research Obligations
In Billions of Constant 1985 Dollars
$3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
NIH
NSF
DOD
DOE
NASA
1979
80
81
82
83
84
85
86
1987
est
Fiscal Year

CHART 2

Dr. McTAGUE. This shows funding across the agencies, and essentially every agency that funds basic research, with the exception of NIH, there is a modest real increase in funding over fiscal year 1985. In the National Institutes of Health, the result for the proposed budget for fiscal year 1987 is artificially low because of the transfer for administrative purposes of funding for AIDS research from NIH to HHS—the Assistant Secretary for Health—$144 million of that will be retransferred for action to NIH, so the actual number is slightly down, a little bit over one percent in constant dollars, and slightly up in current dollars, also for NIH.

The third chart, please.

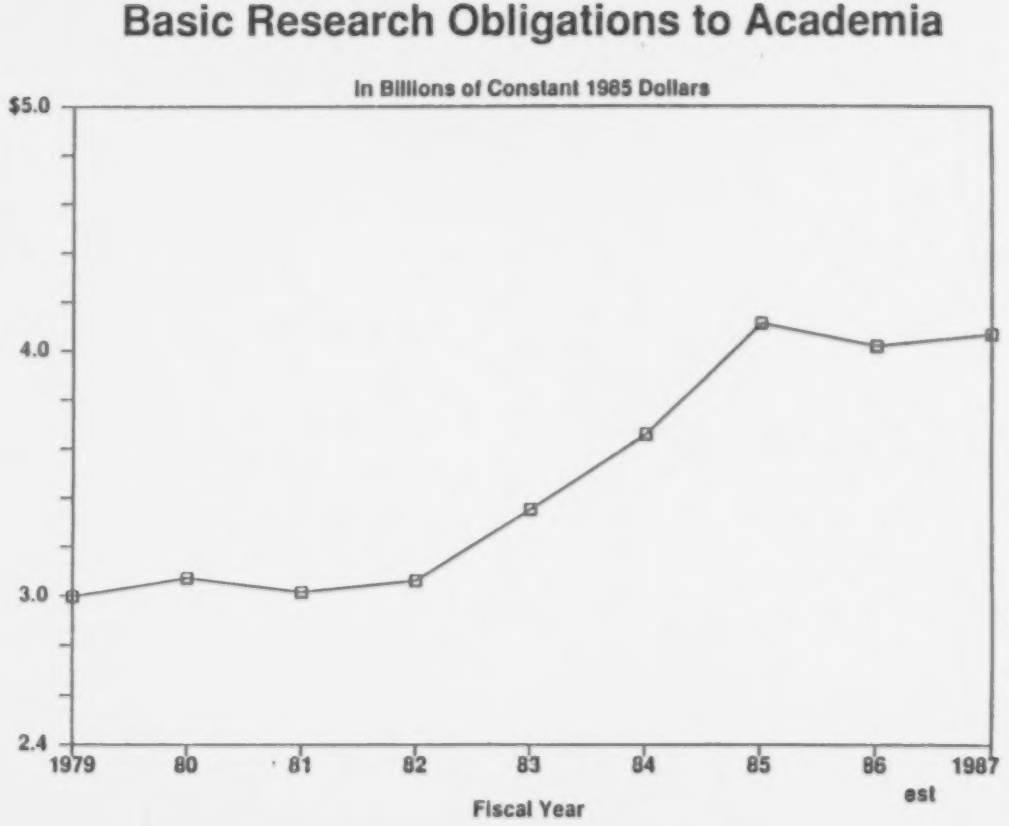

Basic Research Obligations to Academia
In Billions of Constant 1985 Dollars
$5.0
4.0
3.0
2.4
1979
80
81
82
83
84
85
86
1987
est
Fiscal Year

CHART 3

Dr. McTAGUE. Particularly important, we propose to restore the trend of real increases for basic research obligations in our universities.

As in the past, support of basic research, particularly in universities, constitutes a major portion of the President's responsible, austere R&D budget for fiscal year 1987, with funding at a proposed level of $8.6 billion, up from $8 billion.

The National Science Foundation, our flagship supporter of academic basic research, plans three special thrusts for fiscal 1987.

In the realm of biotechnology—burgeoning with possible applications—centers, minicenters, and individual awards will be funded at a level of over $100 million. An additional $27 million will supplement the existing base of $57 million in computational science and engineering to establish new interdisciplinary teams, enhance existing centers, and support equipment and training.

A proposal to more than double the fiscal 1986 level for global geosciences emphasizes interrelated research efforts treating the Earth as an integrated system of physical, chemical, and biological processes.

NSF support is particularly important because it complements the basic research program of the other agencies and assists in balancing Federal support for promising research across all fields of science and engineering.

In addition to its primary role of supporting basic research at colleges and universities through individual project grants, NSF will strive also to provide educational opportunities for future scientists and engineers, with increased emphasis on undergraduate research and education and on research facilities and instrumentation. We simply must attract and retain a larger fraction of our most talented youth in both undergraduate science and engineering programs.

The Department of Energy's General Science Program supports basic research in high energy and nuclear physics. We propose to augment resources in fiscal year 1987 to enhance usage levels for experimental facilities used to understand the basic constituents of matter and energy and the forces that govern their interaction.

Science is never static, and the United States no longer enjoys the luxury of setting the pace at which developments progress. Nevertheless, prioritizing by carefully considering priorities, we have initiated several new starts across the R&D supporting agencies. It will enable the Department of Energy time to take two construction projects, the Continuous Electron Beam Accelerator Facility at Newport News, VA, and the 1 to 2 GeV synchrotron at Lawrence Berkeley Laboratory, while also expanding the use of existing accelerator facilities.

The Tevatron Proton-Antiproton Colliding Beam Facility, recently completed at Fermilab, and the Stanford Linear Collider, world class facilities—world leading facilities, in elementary particle physics research are scheduled to begin operation regaining U.S. leadership in this most fundamental of experimental science, at a time when discovery is occurring at a breakneck pace.

Approximately $200 million is requested for a joint NASA-DOD project to develop and demonstrate the technologies for a revolutionary class of aerospace plane with the ability to take off from and land horizontally on a standard runway, cruise in the atmos-

60-006 0 - 87 - 2

phere at speeds of up to 25 times the speed of sound, or fly into low Earth orbit. There is a model of this remarkable craft here that you might want to take a look at later.

In addition to anticipated benefits in the areas of defense and space activities, the technologies behind this transatmospheric vehicle could lead to a civilian transport aircraft capable of flying to any point on the globe within 3 hours.

NASA plans also to initiate a major new flight project, undertaken jointly with France. The ocean topography experiment known as TOPEX, a further development in the study of oceanography from space, will measure the surface landscape of the oceans over a period of 3 years to further the understanding of the oceans' general circulation patterns.

In addition, NASA proposed to begin instrumentation development for the International Solar-Terrestrial Physics Program [ISTP]. To be planned and executed in conjunction with the European Space Agency and with Japan, ISTP is intended to provide a comprehensive effort to measure phenomena associated with the Sun-Earth interaction chain.

In formulating these plans for the future, we have heeded the advice of several distinguished panels, including the Seitz-Eastman Panel on Large Facilities for Materials Science, which resulted in our proposal for the 1 to 1 GeV synchrotron; the Aeronautical Policy Review Committee, which emphasized the potentials of the aerospace plane; the Space Science Board reports, which recommended both the TOPEX and ISTP projects; and the Nuclear Sciences Advisory Committee, which supported as its No. 1 recommendation for several years the Continuous Electron Beam Accelerator Facility.

But not all recommendations deal with facilities. The Pimentel Panel on Opportunities in Chemistry reported on several high leverage areas, such as chemical instrumentation, maintenance and operation, as well as thrusts in the chemistry of life processes and in chemical catalysis. As a result, the fiscal year 1987 NSF request for chemistry has a 15-percent increase in chemistry funding over fiscal year 1986, and that doesn't even include as the base the Gramm-Rudman-Hollings recission of 1986.

A few years ago, the David Panel reported on the inadequacy of funding for mathematics, as distinguished from computer research. Over the past 2 years, we have increased mathematics funding in NSF and DOD by almost 20 percent in real terms. Again, these responses to valuable advice have been made not because it is good for science, or even because it is good for the Nation, but because it is necessary for the Nation.

In concluding, I would like to say a few words about last week's tragic loss of the seven space pioneers aboard the shuttle *Challenger*. The President and Dr. William Graham, the Acting Administrator of NASA, have initiated comprehensive reviews of the event.

I am confident that the information derived will certify NASA's uncompromising dedication to safety, will reaffirm the quality of the design of the shuttle, will point to new measures for improvement, and will enable us to get on expeditiously with the exploration of the universe.

This is a natural time to examine the role of man in the process. There are many reasons for man to be a space pioneer, rather than just sending computers and sensors alone. We all know that man is the most flexible, most adaptable robot, and thus ideally suited to address the unexpected. That's a good and valid reason for man to be in space, especially in the early stages.

But, to me at least, there are more overriding reasons. Man is intrinsically an explorer. At the dawn of this century, he began to approach the farthest reaches of our two-dimensional Earth surface—the North and South Poles.

A few pioneering heroes, under great hardship and with several deaths, did reach the ultimate extremes, and mankind was enriched when we learned of their feats. But as we now begin to conquer space, the power of telecommunication enables not just a hardy few, but all of us to escape from our two-dimensional world.

This is the epitome of pioneering, and the embracing of change which is at the core of the American character. It is what drives us to push back the frontiers of science and to create economic miracles.

We will soon have more astronauts in space, but even more important, we will have more teachers in space, so that they can make real to younger generations the excitement and power of discovery and innovation.

I cannot think of a more effective investment in the future strength of our Nation than the lessons and inspiration they will give.

Thank you, Mr. Chairman.

[The prepared statement of Mr. McTague follows:]

PROPOSED TESTIMONY OF DR. JOHN P. MCTAGUE
ACTING SCIENCE ADVISOR TO THE PRESIDENT AND
ACTING DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT

BEFORE THE COMMITTEE ON SCIENCE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

HEARINGS ON THE PRESIDENT'S FISCAL YEAR 1987 BUDGET FOR
RESEARCH AND DEVELOPMENT

FEBRUARY 6, 1986

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEE:

IT IS A PLEASURE TO APPEAR BEFORE YOU AS THE COMMITTEE BEGINS ITS DELIBERATIONS ON THE FEDERAL GOVERNMENT'S COURSE IN RESEARCH AND DEVELOPMENT FOR FISCAL YEAR 1987. WE ARE ALL AWARE THAT THIS IS A WATERSHED YEAR FOR FUNDAMENTAL CHANGES WHICH WILL AFFECT ALL SEGMENTS OF OUR NATION FOR MANY YEARS TO COME. LAST YEAR THE CONGRESS AND THE PRESIDENT SET THE STAGE WITH THE ENACTMENT OF THE GRAMM-RUDMAN-HOLLINGS ACT. THIS ENFORCES A DISCIPLINE FOR BUILDING ONE LEG OF THE STOOL FOR THE LONG-TERM STRENGTH AND PROSPERITY OF OUR COUNTRY.

SIMPLY STATED, GRAMM-RUDMAN-HOLLINGS LAYS OUT A SCHEDULE TO WEAN US FROM THE ADDICTION OF SIGNING OUR CHILDREN'S NAMES TO I.O.U.S FOR OUR OWN POCKET MONEY. THIS WITHDRAWAL PROCESS BEGINS IN A FEW WEEKS.

ABSENCE OF CRIPPLING DEBT IS NECESSARY FOR STRENGTH AND PROSPERITY, BUT IT IS NOT SUFFICIENT. WE MUST ALSO HAVE THE MILITARY CAPABILITY TO DETER ANY POTENTIAL AGGRESSOR, AND THE TECHNOLOGICAL AND HUMAN RESOURCES TO COMPETE EFFECTIVELY IN AN INCREASINGLY INTERNATIONAL MARKETPLACE.

THESE ARE THE TWO REMAINING LEGS THAT THE PRESIDENT AND THE CONGRESS ARE ADDRESSING, BEGINNING THIS WEEK. YESTERDAY, THE PRESIDENT SUBMITTED TO THE CONGRESS HIS PROPOSED BUDGET FOR FISCAL YEAR 1987, WHICH SETS THE PRIORITIES FOR ALL THREE LEGS. IT MEETS THE GRAMM-RUDMAN-HOLLINGS TARGET FOR DEFICIT REDUCTION TO 144 BILLION DOLLARS. THIS PLACES A SEVERE CONSTRAINT ON THE DISCRETIONARY COMPONENT OF THE BUDGET, WHICH ITSELF IS ONLY ABOUT ONE-FIFTH OF THE TOTAL FEDERAL BUDGET. THAT MEANS THAT, IN FISCAL YEAR 1987 AND BEYOND, THE FEDERAL GOVERNMENT CAN FUND ONLY THOSE ACTIVITIES THAT ARE NECESSARY FOR IT TO FUND, NOT THOSE WHICH ARE MERELY GOOD AND WORTHY.

THE PRESIDENT HAS HONORED HIS 1985 AGREEMENT WITH THE CONGRESS FOR THREE PERCENT REAL GROWTH IN THE DEFENSE BUDGET FOR FY 1987. THIS ALLOWS FOR CONTINUED MODERNIZATION OF OUR TACTICAL AND STRATEGIC FORCES, WITHIN A FUNDING LEVEL WHICH IS STILL ONE THIRD SMALLER, AS A FRACTION OF GNP, THAN IT WAS IN 1960.

THE PRESIDENT ALSO HAS RENEWED HIS COMMITMENT TO RESEARCH AS THE THIRD LEG, ASSURING INVESTMENT IN THE FUTURE. JUST TWO WEEKS AGO HE STATED, AND I QUOTE, "CONTINUING STRONG SUPPORT FOR OUR NATION'S SCIENCE AND TECHNOLOGY HAS BEEN AND WILL CONTINUE TO BE A POLICY OF THIS ADMINISTRATION. THE GOALS OF THIS SUPPORT ARE ENHANCED NATIONAL SECURITY, IMPROVED QUALITY OF LIFE, AND INCREASED INTERNATIONAL COMPETITIVENESS. TODAY, MORE THAN EVER BEFORE, WE MUST USE OUR TECHNOLOGICAL RESOURCES AGGRESSIVELY IN ORDER TO RETAIN INTERNATIONAL LEADERSHIP." UNQUOTE.

THE PROPOSED FISCAL YEAR 1987 R&D BUDGET GETS US BACK ON AN EVEN KEEL FROM THE FORMULA CUTS OF FISCAL 1986, PARTIALLY RESTORING THE TREND OF REAL GROWTH EXPERIENCED IN THE FIRST HALF OF THE 1980S. BECAUSE OF THE LONG-TERM NATURE OF RESEARCH AND SCIENCE AND ENGINEERING TRAINING, AND THE FRAGILITY OF RESEARCH TEAMS, STEADY, PREDICTABLE FUNDING IS ESPECIALLY IMPORTANT FOR OPTIMIZING FUTURE RETURNS ON OUR R&D INVESTMENT. FROM 1985 TO 1987, BASIC RESEARCH OBLIGATIONS ARE PROPOSED TO RISE AT AN ANNUAL RATE OF 1.7 PERCENT IN REAL TERMS, OR APPROXIMATELY ONE-THIRD OF THE GROWTH RATE EXPERIENCED IN THE FIRST HALF OF THIS DECADE.

IF THERE IS A SINGLE CHARACTERISTIC WHICH EPITOMIZES AMERICA, IT IS HOW WE EMBRACE CHANGE AND PIONEERING AS A WAY OF LIFE. OUR PARENTS AND GRANDPARENTS CAME HERE TO CHANGE THEIR LIVES, AND THOUSANDS UPON THOUSANDS STILL DO SO TODAY. THE EDISONS, WRIGHTS, AND FORDS OF AN EARLIER GENERATION USED THEIR INDIVIDUAL INVENTIVENESS TO MAKE A REALITY OUT OF THE SEEMINGLY IMPOSSIBLE, AND CREATED WHOLE NEW CLASSES OF INDUSTRIES WHICH UNDERLIE THE NATION'S STRENGTH, PROSPERITY, AND QUALITY OF LIFE.

IN THE SECOND HALF OF THE TWENTIETH CENTURY, WE MORE CONSCIOUSLY INVESTED IN NEW TECHNOLOGY AS THE OUTPUT FROM A CONTINUUM OF NEW SCIENTIFIC KNOWLEDGE AND NEW ENGINEERING APPROACHES. THE RESULTS INCLUDED MILITARY AND COMMERCIAL JET AIRCRAFT, LASERS, COMPUTERS, AND THE ENORMOUS FIELD OF MICROELECTRONICS. WE STRONGLY BENEFITED FROM BASIC RESEARCH, ESPECIALLY THAT CARRIED OUT AT OUR UNIVERSITIES, AND FROM THE SCIENTISTS AND ENGINEERS TRAINED THERE IN A FORWARD-LOOKING RESEARCH ENVIRONMENT.

THESE LESSONS HAVE NOT BEEN LOST ON THE OTHER NATIONS OF THE INDUSTRIALIZED AND INDUSTRIALIZING WORLD. THEY TOO HAVE LEARNED HOW TO SYSTEMATIZE TECHNOLOGICAL INNOVATION, AND HAVE NARROWED DRAMATICALLY THE TECHNOLOGICAL LEADERSHIP GAP. UNIVERSALLY, AN INCREASING FRACTION OF GNP IS BEING INVESTED ON RESEARCH AND DEVELOPMENT, WITH JAPAN SHOWING THE MOST DRAMATIC ACCELERATION, AS WELL AS SHOWING AN

INCREASING CONCERN FOR BASIC RESEARCH, THE AREA WHICH THE U.S. CLEARLY HAS PREDOMINATED FOR MANY DECADES.

UNLESS WE RESPOND EFFECTIVELY TO THIS CHALLENGE, WE FACE A CERTAIN LOSS OF TECHNOLOGICAL AND ECONOMIC LEADERSHIP IN THE WORLD, WITH CONSEQUENCES WHICH ARE NOT MEASURED IN DOLLARS ALONE. IN SHORT, WE NEED A NEW NATIONAL SCIENCE AND TECHNOLOGY STRATEGY AS WE BEGIN TO APPROACH THE TWENTY-FIRST CENTURY. FORTUNATELY, WE ALREADY HAVE THE SEEDS OF THAT STRATEGY PLANTED ACROSS OUR COUNTRY. AND IT DOES NOT REQUIRE A MASSIVE INFUSION OF INCREASED FEDERAL FUNDING, BUT RATHER MORE EFFECTIVE USE OF WHAT WE HAVE, TOGETHER WITH THE REASONABLE, STEADY INCREASES THE PRESIDENT HAS PROPOSED.

THE RAPID EMERGENCE OF MODERN BIOTECHNOLOGY INDUSTRIES IN THE U.S. PROVIDES A LESSON WORTH STUDYING. HERE, ENLIGHTENED FEDERAL SUPPORT OF MULTIDISCIPLINARY BASIC RESEARCH IN MOLECULAR BIOLOGY, BOTH IN UNIVERSITIES AND FEDERAL LABORATORIES, LED TO THE REVOLUTIONARY TECHNOLOGY OF GENE SPLICING. CLOSE TWO-WAY COUPLING BETWEEN UNIVERSITY RESEARCHERS AND COMMERCIAL ENTITIES FOSTERED RAPID TRANSFER OF THE GENETIC TECHNOLOGY TO ENGINEERING OF SPECIFIC PRODUCTS AND CREATED A WHOLE NEW, ALBEIT INFANT, INDUSTRY IN WHICH WE HAVE A WORLD LEAD.

THIS EXAMPLE TEACHES SEVERAL LESSONS. ONE IS THAT THE MOST EFFECTIVE FEDERAL ROLE IS NOT TO ATTEMPT TO DRIVE SPECIFIC COMMERCIAL TECHNOLOGIES, BUT TO SUPPORT FOREFRONT BASIC RESEARCH, WHICH WILL HAVE PAYOFFS NOT FORESEEABLE AT THE TIME OF FUNDING. THE SECOND IS THAT MULTIDISCIPLINARY EFFORTS CAN BE EXCEPTIONALLY EFFECTIVE IN ADVANCING OUR KNOWLEDGE. THE THIRD IS THAT PERSON-TO-PERSON, UNIVERSITY-INDUSTRY RESEARCH RELATIONSHIPS CAN BENEFIT BOTH PARTNERS WITHOUT COMPROMISING THE ACADEMIC ENVIRONMENT WE SO CHERISH.

MODEST REDIRECTIONS OF OUR FEDERAL R&D INVESTMENT TO ENCOURAGE THESE TRENDS, WITHOUT PERTURBING THE PREDOMINATELY DISCIPLINARY STRUCTURE OF OUR UNIVERSITIES, COULD HAVE HIGH PAYOFF FOR OUR NATION, SO THAT IT WILL CONTINUE TO LEAD THE WORLD IN CREATING THE NEXT GENERATION OF NEW INDUSTRIES, WHATEVER THEY MAY BE.

A PRINCIPAL OBSERVATION OF THE PRESIDENT'S COMMISSION ON INDUSTRIAL COMPETITIVENESS, STILL INSTRUCTIVE A YEAR AFTER THE PUBLICATION OF ITS REPORT, WAS THE VALUE OF ENCOURAGING STRONGER TIES BETWEEN GOVERNMENT, UNIVERSITIES, AND INDUSTRY, SUGGESTING THAT THEIR TRADITIONAL ALOOFNESS WAS NOT IN THE BEST INTEREST OF THE NATION. THE TRANSITION FROM BASIC SCIENCE TO TECHNOLOGY TO PRODUCT IS OCCURRING MORE AND MORE RAPIDLY, AND WILL CONTINUE TO ACCELERATE IN THE FUTURE. MOREOVER, IT IS NOT A ONE-WAY STREET. SCIENCE

BENEFITS FROM TECHNOLOGY AND ITS PRODUCTS IN COMPARABLE MEASURE. THUS, CLOSER RELATIONSHIPS MORE IN THE SPIRIT OF A PARTNERSHIP COULD BE MUTUALLY--AND NATIONALLY--BENEFICIAL.

TYPICALLY, GOVERNMENT BEARS THE RESPONSIBILITY FOR FUNDING RESEARCH WHERE A MARKETABLE RETURN ON THE INVESTMENT IS NEITHER GUARANTEED NOR IMMEDIATELY OBVIOUS. INDUSTRY SUPPORTS AND CONDUCTS RESEARCH WITH GREATER POTENTIAL FOR SHORT-TERM PAYOFF. THE UNIVERSITY BALANCES IN THE MIDDLE, AS THE LOCUS OF MOST OF OUR BASIC RESEARCH AND THE SUPPLIER OF THE HIGHLY-TRAINED TALENT WHICH ULTIMATELY GOES TO WORK FOR INDUSTRY. THE LOGIC OF THIS CONFIGURATION DOES NOT PRECLUDE REFINEMENTS, PARTICULARLY WHEN OUR NATION'S COMPETITIVE POSTURE IN THE INTERNATIONAL MARKETPLACE IS AT STAKE. FOR THIS REASON WE ARE AGGRESSIVELY PURSUING AN INITIATIVE TO ESTABLISH UNIVERSITY-BASED, MULTIDISCIPLINARY, PROBLEM-FOCUSED, SCIENCE AND TECHNOLOGY CENTERS AIMED AT AREAS OF BROAD NATIONAL NEEDS AND RELEVANT TO INDUSTRIAL TECHNOLOGY.

THE WORKING MODEL FOR THIS SORT OF ARRANGEMENT IS THE NATIONAL SCIENCE FOUNDATION'S EMMINENTLY SUCCESSFUL ENGINEERING RESEARCH CENTERS PROGRAM, BEGUN IN 1985 FOLLOWING AN OVERWHELMING RESPONSE FROM THE ACADEMIC COMMUNITY. THERE ARE NOW SIX SUCH CENTERS ADDRESSING A WIDE VARIETY OF RESEARCH AREAS INCLUDING ROBOTICS,

BIOTECHNOLOGY, COMPOSITE MATERIALS MANUFACTURING, AND INTELLIGENT MANUFACTURING SYSTEMS. IMPORTANTLY, THE FUNDING AGREEMENT STIPULATED THAT PARTICIPATING UNIVERSITIES AND INDUSTRIES COLLABORATE IN DEFINING THE AREAS OF RESEARCH TO PURSUE, BASED ON MUTUAL NEEDS. IN ADDITION TO AMMASSING THE FORCES OF INDUSTRIAL AND ACADEMIC SCIENTISTS TO SOLVE TECHNOLOGICAL QUESTIONS WITH ECONOMIC IMPLICATIONS, THESE CENTERS COINCIDENTALLY PROVIDE A HIGHLY STIMULATING RESEARCH AND LEARNING ENVIRONMENT--A TRAINING GROUND OF UNPARALLELED OPPORTUNITY FOR GRADUATE AND UNDERGRADUATE STUDENTS ALIKE. NSF PLANS TO ADD MORE ENGINEERING RESEARCH CENTERS DURING THE CURRENT FISCAL YEAR, AND THE FY '87 BUDGET REQUEST CONTAINS PLANS FOR THE OPERATION OF A TOTAL OF ABOUT 15. THIS IS A GOOD BEGINNING, BUT ONLY A BEGINNING. THIS CONCEPT DESERVES EMULATION ACROSS THE BROAD SPECTRUM OF INTERDISCIPLINARY SCIENCE, MATHEMATICS, AND ENGINEERING. INDEED, DOD HAS ALREADY BEGUN EFFORTS IN THIS DIRECTION THROUGH ITS UNIVERSITY RESEARCH INITIATIVE.

NOTABLY, MULTIDISCIPLINARY, PROBLEM-ORIENTED SCIENCE AND TECHNOLOGY CENTERS ESTABLISHED COOPERATIVELY BY UNIVERSITY AND INDUSTRY ON CAMPUSES ARE AMONG THE FOREMOST RECOMMENDATIONS OF THE WHITE HOUSE SCIENCE COUNCIL'S PANEL ON THE HEALTH OF U.S. COLLEGES AND UNIVERSITIES, WHOSE REPORT IS DUE OUT SHORTLY. CHAIRED JOINTLY BY A LEADER IN HIGH-TECHNOLOGY INDUSTRY, DAVID PACKARD, AND A PREEMINENT

UNIVERSITY PHYSICIST, D. ALLAN BROMLEY, THIS PANEL URGENTLY STRESSED THE NEED TO ENABLE OUR COLLEGES AND UNIVERSITIES TO GROW COMMENSURATE WITH SOCIETY'S GROWING DEMAND FOR THE NEW KNOWLEDGE AND NEW TALENT WHICH IS THEIR PRODUCT. THIS CALLS FOR AN INCREASED FEDERAL INVESTMENT IN HIGHER EDUCATION AND FOR SPECIAL ATTENTION TO THE MAINTENANCE OF MODERN RESEARCH FACILITIES AND INSTRUMENTATION ON OUR NATION'S CAMPUSES--A CALL WE INTEND TO HEED.

AS IN THE PAST, SUPPORT OF BASIC RESEARCH, PARTICULARLY IN UNIVERSITIES CONSTITUTES A MAJOR PORTION OF THE PRESIDENT'S RESPONSIBLE, AUSTERE R&D BUDGET FOR FISCAL YEAR 1987, WITH FUNDING AT A PROPOSED LEVEL OF $8.6 BILLION. THE NATIONAL SCIENCE FOUNDATION, AMONG THE LARGEST CIVILIAN SUPPORTER OF ACADEMIC BASIC RESEARCH, PLANS THREE SPECIAL THRUSTS FOR FY '87. IN THE REALM OF BIOTECHNOLOGY--BURGEONING WITH POSSIBLE APPLICATIONS--CENTERS, MINI-CENTERS, AND INDIVIDUAL AWARDS WILL BE FUNDED AT A LEVEL OF OVER $100 MILLION. AN ADDITIONAL $27 MILLION WILL SUPPLEMENT THE EXISTING BASE OF $57 MILLION IN COMPUTATIONAL SCIENCE AND ENGINEERING TO ESTABLISH NEW INTERDISCIPLINARY TEAMS, ENHANCE EXISTING CENTERS, AND SUPPORT EQUIPMENT AND TRAINING. A PROPOSAL TO MORE THAN DOUBLE THE FY '86 FUNDING LEVEL FOR GLOBAL GEOSCIENCES EMPHASIZES INTERRELATED RESEARCH EFFORTS TREATING THE EARTH AS AN INTEGRATED SYSTEM OF PHYSICAL, CHEMICAL, AND BIOLOGICAL PROCESSES.

NSF SUPPORT IS PARTICULARLY IMPORTANT BECAUSE IT COMPLEMENTS THE BASIC RESEARCH PROGRAM OF OTHE AGENCIES AND ASSISTS IN BALANCING FEDERAL SUPPORT FOR PROMISING RESEARCH ACROSS ALL FIELDS OF SCIENCE AND ENGINEERING. IN ADDITION TO ITS PRIMARY ROLE OF SUPPORTING BASIC RESEARCH AT COLLEGES AND UNIVERSITIES THROUGH INDIVIDUAL PROJECT GRANTS, NSF WILL STRIVE ALSO TO PROVIDE EDUCATIONAL OPPORTUNITIES FOR FUTURE SCIENTISTS AND ENGINEERS, WITH INCREASED EMPHASIS ON UNDERGRADUATE RESEARCH AND EDUCATION AND ON RESEARCH FACILITIES AND INSTRUMENTATION. WE SIMPLY MUST ATTRACT AND RETAIN A LARGER FRACTION OF OUR MOST TALENTED YOUTH IN BOTH UNDERGRADUATE SCIENCE AND ENGINEERING PROGRAMS.

THE DEPARTMENT OF ENERGY'S GENERAL SCIENCE PROGRAM SUPPORTS BASIC RESEARCH IN HIGH ENERGY AND NUCLEAR PHYSICS. A PROPOSAL TO AUGMENT RESOURCES IN FISCAL YEAR 1987 WILL ENHANCE SUPPORT FOR EXPERIMENTAL EFFORTS TO UNDERSTAND THE BASIC CONSTITUTUENTS OF MATTER AND ENERGY AND THE FORCES THAT GOVERN THEIR INTERACTION.

SCIENCE IS NEVER STATIC, AND THE UNITED STATES NO LONGER ENJOYS THE LUXURY OF SETTING THE PACE AT WHICH DEVELOPMENTS PROGRESS. PERHAPS THE MOST HEARTENING ASPECT OF THE PROPOSED FY '87 R&D BUDGET IS THE FACT THAT FISCAL RESTRAINT DOES NOT PREVENT A VERITABLE BLOSSOMING OF

EXCITING NEW STARTS ACROSS THE R&D-SUPPORTING AGENCIES. IT WILL ENABLE THE DEPARTMENT OF ENERGY TO UNDERTAKE TWO CONSTRUCTION PROJECTS, THE CONTINUOUS ELECTRON BEAM ACCELERATOR FACILITY AT NEWPORT NEWS, VIRGINIA, AND THE 1-2 GEV SYNCHROTRON AT LAWRENCE BERKELEY LABORATORY, WHILE ALSO EXPANDING THE USE OF EXISTING ACCELERATOR FACILITIES. THE TEVATRON I PROTON-ANTIPROTON COLLIDING BEAM FACILITY, RECENTLY COMPLETED AT FERMILAB, AND THE STANFORD LINEAR COLLIDER, ARE SCHEDULED TO BEGIN OPERATION, REGAINING U.S. LEADERSHIP IN THIS MOST FUNDAMENTAL OF EXPERIMENTAL SCIENCES AT A TIME WHEN DICOVERY IS OCCURRING AT A BREAKNECK PACE.

APPROXIMATELY $200 MILLION IS REQUESTED FOR A JOINT NASA-DOD PROJECT TO DEVELOP AND DEMONSTRATE THE TECHNOLOGIES FOR A REVOLUTIONARY CLASS OF AEROSPACE PLANE WITH THE CAPABILITY TO TAKE OFF FROM AND LAND HORIZONTALLY ON A STANDARD RUNWAY, CRUISE IN THE ATMOSPHERE AT SPEEDS OF UP TO TWENTY-FIVE TIMES THE SPEED OF SOUND, OR FLY INTO LOW EARTH ORBIT. IN ADDITION TO ANTICIPATED BENEFITS IN THE AREAS OF DEFENSE AND SPACE ACTIVITIES, THE TECHNOLOGIES BEHIND THIS TRANSATMOSPHERIC VEHICLE COULD LEAD TO A CIVILIAN TRANSPORT AIRCRAFT CAPABLE OF TRAVELING TO ANY POINT ON THE GLOBE WITHIN THREE HOURS.

NASA PLANS ALSO TO INITIATE A MAJOR NEW FLIGHT PROJECT, UNDERTAKEN JOINTLY WITH FRANCE. THE OCEAN TOPOGRAPHY EXPERIMENT (TOPEX), A FURTHER DEVELOPMENT IN THE STUDY OF OCEANOGRAPHY FROM SPACE, WILL MEASURE THE SURFACE LANDSCAPE OF THE OCEANS OVER A PERIOD OF THREE YEARS TO FURTHER THE UNDERSTANDING OF THE OCEANS' GENERAL CIRCULATION PATTERNS. IN ADDITION, NASA WILL BEGIN INSTRUMENT DEVELOPMENT FOR THE INTERNATIONAL SOLAR-TERRESTRIAL PHYSICS (ISTP) PROGRAM. TO BE PLANNED AND EXECUTED IN CONJUNCTION WITH THE EUROPEAN SPACE AGENCY AND JAPAN, ISTP IS INTENDED TO PROVIDE A COMPREHENSIVE EFFORT TO MEASURE PHENOMENA ASSOCIATED WITH THE SUN-EARTH INTERACTION CHAIN.

IN FORMULATING THESE PLANS FOR THE FUTURE, WE HAVE HEEDED THE ADVICE OF SEVERAL DISTINGUISHED PANELS, INCLUDING THE SEITZ-EASTMAN PANEL ON LARGE FACILITIES FOR MATERIALS SCIENCE (FOR THE 1-2 GEV SYNCROTRON), THE AERONAUTICAL POLICY REVIEW COMMITTEE (FOR THE AEROSPACE PLANE), THE SPACE SCIENCE BOARD REPORTS (FOR TOPEX AND ISTP), AND THE NUCLEAR SCIENCES ADVISORY COMMITTEE (FOR THE CONTINUOUS ELECTRON BEAM ACCELERATOR FACILITY).

BUT NOT ALL RECOMMENDATIONS DEAL WITH FACILITIES. THE PIMENTEL PANEL ON OPPORTUNITIES IN CHEMISTRY REPORTED ON SEVERAL HIGH-LEVERAGE AREAS, SUCH AS CHEMICAL INSTRUMENTATION, MAINTENANCE AND OPERATION, AS WELL AS THRUSTS IN THE CHEMISTRY OF LIFE PROCESSES AND IN CHEMICAL

CATALYSIS. AS A RESULT, THE FY '87 NSF REQUEST FOR CHEMISTRY HAS A 15 PERCENT INCREASE IN CHEMISTRY FUNDING OVER FY '86, NOT INCLUDING THE GRAMM-RUDMAN-HOLLINGS RECISSION.

A FEW YEARS AGO, THE DAVID PANEL REPORTED ON THE INADEQUACY OF FUNDING FOR MATHEMATICS, AS DISTINGUISHED FROM COMPUTER, RESEARCH. OVER THE PAST TWO YEARS, WE HAVE INCREASED MATHEMATICS FUNDING IN NSF AND DOD BY ALMOST 20 PERCENT IN REAL TERMS.

AGAIN, THESE RESPONSES TO VALUABLE ADVICE HAVE BEEN MADE NOT BECAUSE IT IS GOOD FOR SCIENCE, OR EVEN BECAUSE IT IS GOOD FOR THE NATION, BUT BECAUSE IT IS NECESSARY FOR THE NATION.

IN CONCLUDING, I WOULD LIKE TO SAY A FEW WORDS ABOUT LAST WEEK'S TRAGIC LOSS OF THE SEVEN SPACE PIONEERS ABOARD THE SHUTTLE CHALLENGER. THE PRESIDENT AND DR. WILLIAM GRAHAM, ACTING ADMINISTRATOR OF NASA, HAVE INITIATED COMPREHENSIVE REVIEWS OF THE EVENT. I AM CONFIDENT THAT THE INFORMATION DERIVED WILL CERTIFY NASA'S UNCOMPROMISING DEDICATION TO SAFETY, WILL REAFFIRM THE QUALITY OF THE DESIGN OF THE SHUTTLE, WILL POINT TO NEW MEASURES FOR IMPROVEMENT, AND WILL ENABLE US TO GET ON EXPEDITIOUSLY WITH THE EXPLORATION OF THE UNIVERSE.

THIS IS A NATURAL TIME TO EXAMINE THE ROLE OF MAN IN THE PROCESS. THERE ARE MANY REASONS FOR MAN TO BE A SPACE PIONEER, RATHER THAN SENDING JUST COMPUTERS AND SENSORS ALONE. WE ALL KNOW THAT MAN IS THE MOST FLEXIBLE, MOST ADAPTABLE "ROBOT", AND THUS IDEALLY SUITED TO ADDRESS THE UNEXPECTED. THAT'S A GOOD AND VALID REASON FOR MAN TO BE IN SPACE.

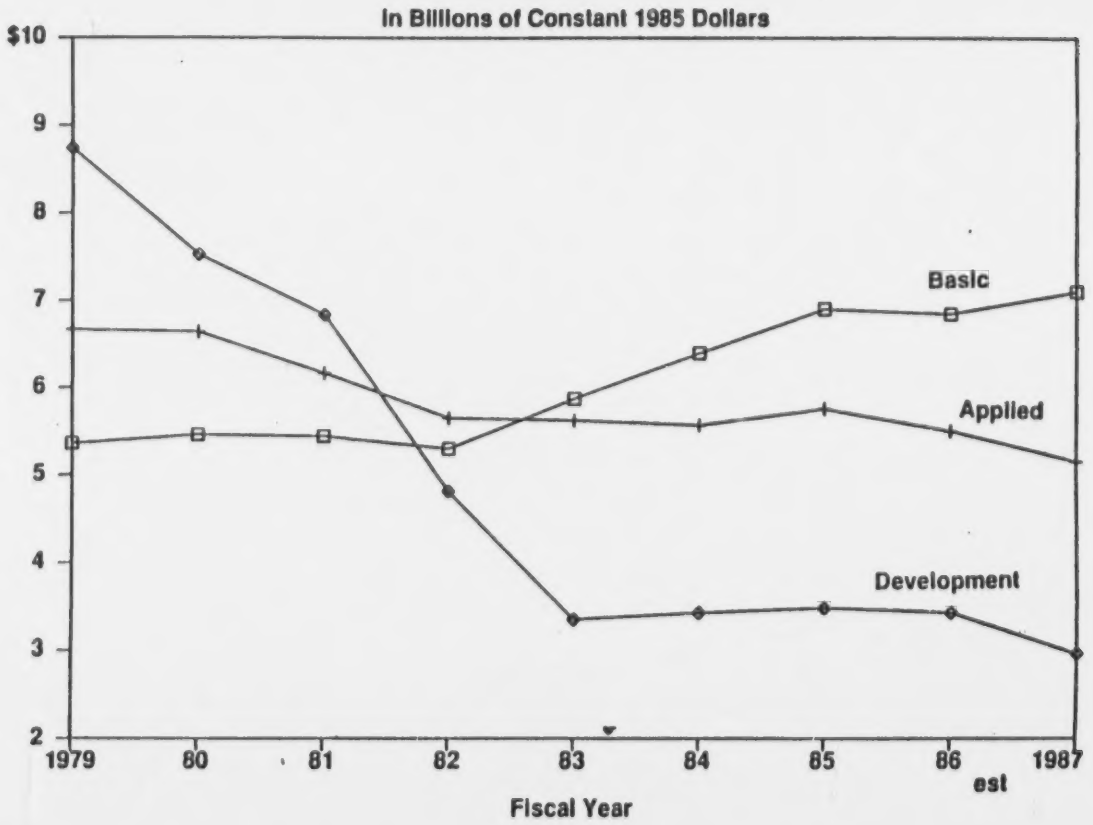
BUT, TO ME AT LEAST, THERE ARE MORE OVERRIDING REASONS. MAN IS INTRINSICALLY AN EXPLORER. AT THE DAWN OF THIS CENTURY, HE BEGAN TO APPROACH THE FARTHEST REACHES OF OUR TWO-DIMENSIONAL EARTH SURFACE--THE NORTH AND SOUTH POLES. A FEW PIONEERING HEROES, UNDER GREAT HARDSHIP AND WITH SEVERAL DEATHS, DID REACH THE ULTIMATE EXTREMES, AND MANKIND WAS ENRICHED WHEN WE LEARNED OF THEIR FEATS. BUT AS WE NOW BEGIN TO CONQUER SPACE, THE POWER OF TELECOMMUNICATION ENABLES NOT JUST A HARDY FEW, BUT ALL OF US TO ESCAPE FROM OUR TWO-DIMENSIONAL WORLD. THIS IS THE EPITOME OF PIONEERING, AND THE EMBRACING OF CHANGE WHICH IS AT THE CORE OF THE AMERICAN CHARACTER. IT IS WHAT DRIVES US TO PUSH BACK THE FRONTIERS OF SCIENCE AND TO CREATE ECONOMIC MIRACLES.

WE WILL SOON HAVE MORE ASTRONAUTS IN SPACE, BUT EVEN MORE IMPORTANT, WE WILL HAVE MORE TEACHERS IN SPACE, SO THAT THEY CAN MAKE REAL TO YOUNGER GENERATIONS THE EXCITEMENT AND POWER OF DISCOVERY AND INNOVATION. I CANNOT

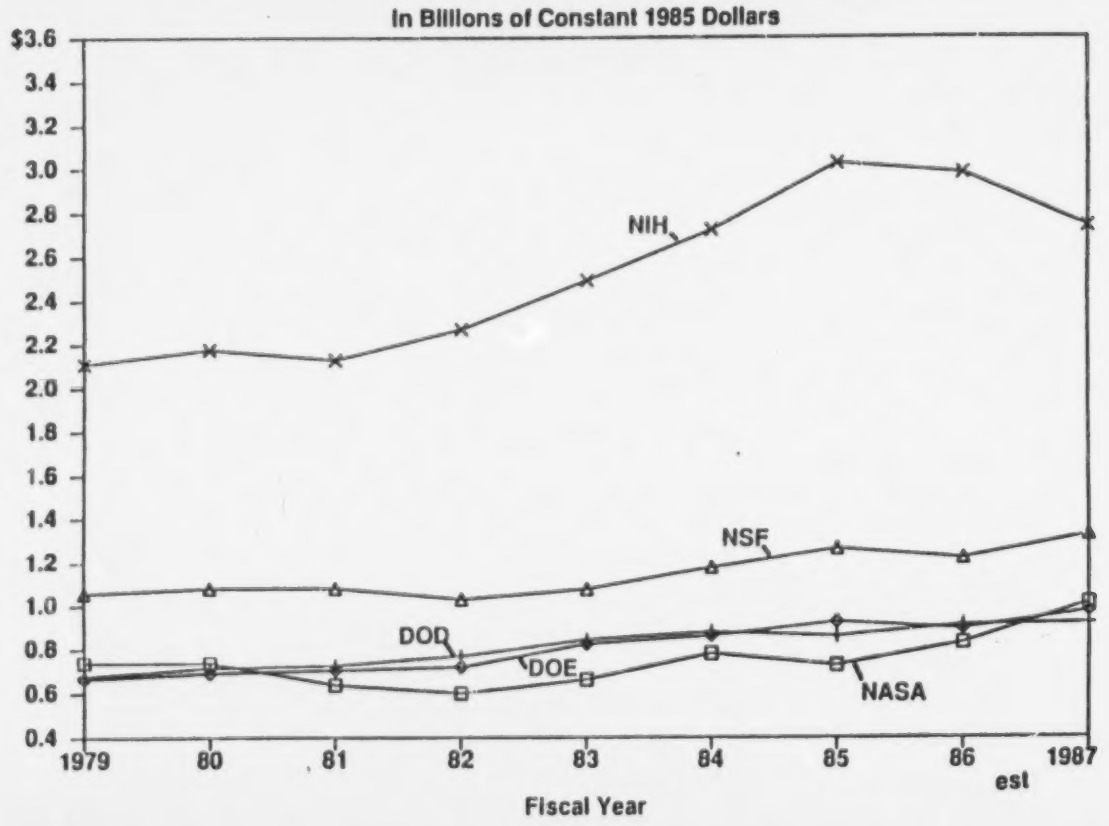
THINK OF A MORE EFFECTIVE INVESTMENT IN THE FUTURE STRENGTH OF OUR NATION THAN THE LESSONS AND INSPIRATION THEY WILL GIVE.

####

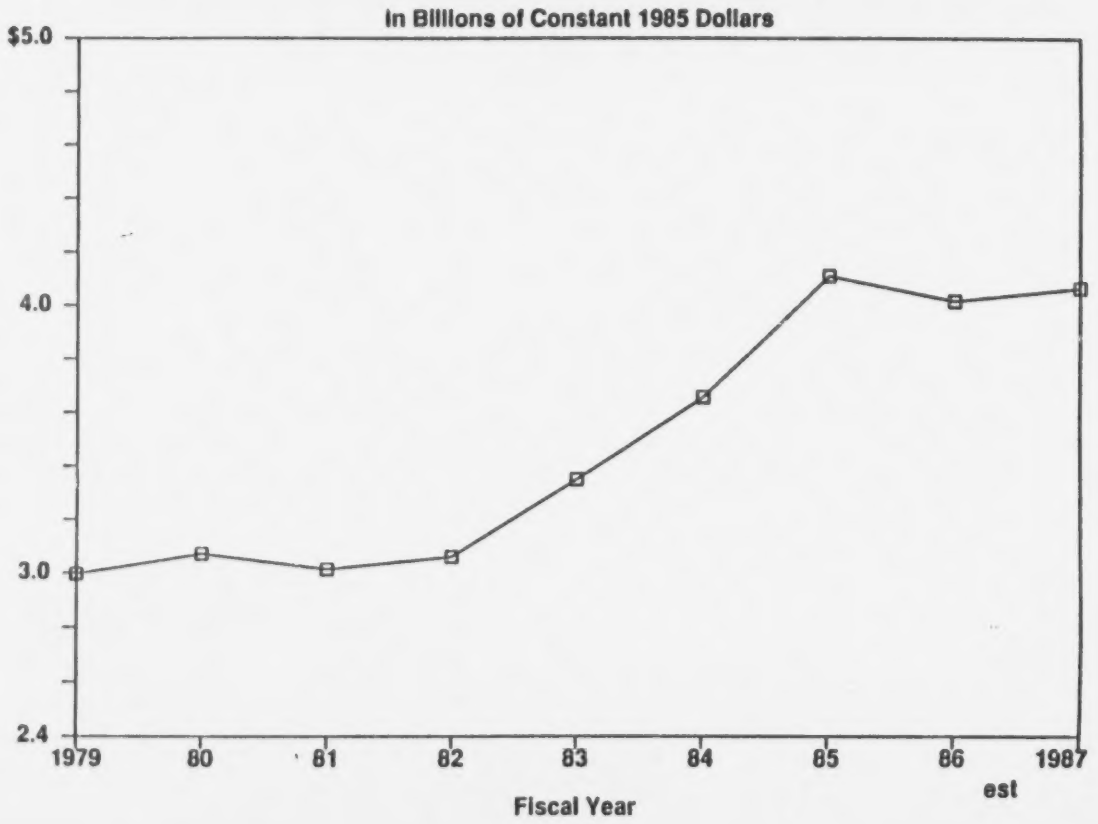
Federal R&D Obligations (Nondefense)



Basic Research Obligations



Basic Research Obligations to Academia



Mr. FUQUA. Thank you very much, Dr. McTague, and we appreciate you being here with us today.

On page 9, you mention the Packard-Bromley report relating to facilities and instrumentation, and you, in quoting it said it calls for an increased Federal investment; special attention to the maintenance of modern research facilities and instrumentation—and it says a call we intend to heed.

Is there anything in the budget to implement that report?

Dr. MCTAGUE. There are several things which are ongoing which address the general thrusts of the Bromley report, including the enhancement of the program for engineering research centers in the National Science Foundation, addressing multidisciplinary research, and centers' activities through the university research initiative in the Department of Defense. Both agencies are increasing their investment in——

Mr. FUQUA. Will the Department of Defense be providing money for facilities and instrumentation?

Dr. MCTAGUE. They will be providing funds for instrumentation. There are no specific facilities construction fundings earmarked for either agency. They are permissive within the guidelines of the funding levels that do exist. Both for the National Science Foundation, which changed its rules last year, this past year, to state that facilities' requests can also compete for available funds in the general guidelines that exist in the Department of Defense. By no means is this a complete and adequate response. The report is not formally in yet. We expect to make further recommendations, many of which will undoubtedly parallel your own bill, in the near future, and I look forward to working closely with this committee on assuring that the universities are able to do what we call upon them to do for our future prosperity.

Mr. FUQUA. In recent years, the Department of Agriculture has been moving in some direction toward competitive grants.

Dr. MCTAGUE. Yes.

Mr. FUQUA. What happened in those funds under this budget?

Dr. MCTAGUE. They are held approximately constant under fiscal 1987 budget due to the severe pressure on the Department of Agriculture budget in general, which I believe is the most severely impacted budget of any major department.

Mr. FUQUA. Well, I also notice that the National Bureau of Standards has again been victimized by the axe, and I am wondering how this is going to affect the long-term health of the Bureau and its ability to help U.S. industry remain competitive in the world marketplace.

Dr. MCTAGUE. I would like to state, first, that it is certainly my own impression and firm belief that the National Bureau of Standards is a very important and not thoroughly appreciated national resource at the interface between basic research and industrial application. I think they do a marvelous job of cooperating both with industry and universities.

There are new programs in the National Bureau of Standards and enhanced programs this year, including, once again, the proposal for a construction project for the cold neutron guide haul which I believe is essential to maintaining national preeminence in this area of great industrial as well as basic research interests.

There is enhanced activity in the area of fiber optics and in advanced ceramics within a severely constrained budget which is approximately constant in current dollars.

The CHAIRMAN. Let me commend you for the model you have by you. The President referred to it as the Orient Express. I don't know where he got that name from but I have an idea. I think that we are certainly moving in the right direction.

There has been some expression made by some people that probably it could replace the space shuttle *Challenger* that we lost the other day. Is it moving along in that direction that it would be available for use by NASA by 1989 or 1990?

Dr. MCTAGUE. The program for the national aerospace plane involves some very great technological challenges. Over the period 1986 through 1988, we propose a significant technological program to refine the technologies for advanced materials, for advanced propulsion systems—ramjets and scramjets, for integration of a prototype vessel which will be a very challenging effort because this particular vehicle involves complete integration of the engine into the fuselage. They are not separate components of the air intake into the fuselage, of the fuel containers into the fuselage, of cooling elements which may or may not involve the use of the fuel. It's a true challenge whose pace will be controlled by the pace of integrating and refining these technologies.

It would be difficult to accelerate—if not impossible—to accelerate the rate of—of progress beyond getting to the stage of making a decision on building a prototype vessel before sometime in the 1988 framework. That means that if at that stage we do opt to proceed ahead, we do not expect to have a demonstration prototype until some period in the mid-1990's.

In the long run, such a vehicle offers exceptionally great promise for carrying payloads into low Earth orbit with potential cost of carrying a payload being conservatively estimated at one-tenth that of the present shuttle, and optimistically estimated at about one-hundredth of that. But such an operational vessel is clearly more than a decade into the future and will not solve the short-term needs of our space program.

Mr. FUQUA. Mr. Boehlert.

[No response.]

Mr. FUQUA. Mr. Fawell.

Mr. FAWELL. Doctor, on page 7 of your comments, you set forth that, and I quote: "We are aggressively pursuing an initiative to establish university-based, multidisciplinary, problem-focused, science and technology centers aimed at areas of broad national needs and relevant to industrial technology."

Well, does that mean in any way that use of your national laboratories is the emphasis is diminishing there, and that this is the wave of the future to——

Dr. MCTAGUE. Absolutely not. I think they are parallel and complimentary facilities, and I would point out that a major reason for the founding and operation of the multipurpose national laboratories was to provide for universities and for other uses facilities that are on such a scale that they are not appropriate or feasible for individual universities.

In particular, I am vividly reminded of where I came from before I came to Washington. I was the director of such a facility at Brookhaven National Laboratories, the national synchrotron light source, which had in its early phases about 400 users, one-third of whom were from universities, one-third of whom were from industry, and one-third of whom were from other national laboratories, and other Federal laboratories—and which had funding for facilities there of some $20 million invested by industry and many millions of dollars of beam lines put in by university research groups. I consider this highly appropriate.

The national laboratories also serve other good and worthy causes for the Nation. I see the two of them as complimentary, the universities and the laboratories. It is in our interest and, in fact, necessary, for us to get them operating even more closely together.

Mr. FAWELL. I assume we are talking about a greater emphasis on wrong research, though, and less in regard to actual development.

Now, how—insofar as industry is concerned in the commercial aspect here, what is being done to assure that we are not going to lag on development actually?

I am thinking in terms—for instance, of acid rain. We have talked so much about that and I have know a number of people that have contacted me who have demonstration projects and they feel that they are stymied here, the research, raw research is being done, but as far as demonstration projects, they can't find a readiness in industry to tackle this, and I gather not a readiness by Government either.

Dr. MCTAGUE. With your permission, I would like to answer that question in general terms followed by specific terms related to acid rain.

In general terms, it has been the policy of this administration to get the Government out of development as it approaches the commercial phase from the point of view that the marketplace is a better judge of commercialization than the Government. Our history has not been very good as a Government, however benevolent our intent has been to drive specific commercialized technologies.

As the Government has got out of the development phase of the commercialized development phases, in fact, industry has very greatly increased its investment in R&D, and over the past decade or so it has been growing at an average annual rate in excess of 7-percent faster than Federal R&D investment has been growing.

So that is an encouraging factor, I think. You are seeing a separation of responsibility between the Government doing what industry cannot do, which is the long-term generic basic research, and industry focusing more on the shorter term, commercializable aspects.

We do still do development activities in areas where the Government is the consumer or in highly regulated industries where it is difficult for the marketplace to predict where to go because Government regulations change so often.

With respect to the area of acid rain, there is significant funding across several agencies. I believe there is an increase in funding in EPA for acid rain research activities. I am not familiar with the

level to which they fund demonstration projects in private industry, but I would be glad to get those facts for you in written reply.

Mr. FAWELL. Is this increase insofar as development projects are concerned true in the civilian-oriented as well as in defense, or is there a lot of difference in percentages there?

Dr. MCTAGUE. There is in the Government a significant increase of cost in development projects; a substantial increase in development projects related to the military. On average, development in the Government outside the Defense Department is substantially down, with notable exceptions. For example, in NASA this year there is increase in development funding.

Mr. FAWELL. Thank you.

Mr. FUQUA. Thank you, Mr. Fawell.

Mr. Brown.

Mr. BROWN. Dr. McTague, I want to compliment you on the general thrust of your statement, and say as I have before to your predecessor, that there are many very sound and important aspects of the administration's science and technology policy which I support, and I know the committee supports very wholeheartedly.

I don't want to dwell on those, however, because that's not where the rub comes. The rub comes with something like the aerospace plane in which you are pioneering in a move, a policy initiative in which you have a number of different Government departments cooperating with industry and research in a project which is in the national interest and which will maintain our national leadership in Defense, commerce, and probably in basic research as well.

But the problem that we perceive is in establishing the criteria, as a matter of science and technology policy, for getting involved in something like that which is a matter of national interest. And I am not yet sure how this administration draws those lines, nor am I satisfied with much of what I see. As an example, this committee and the Congress recognized years ago the need for the development of multidisciplinary engineering research centers. We embodied that in legislation such as Stevenson-Wydler, which the administration rejected. And now you are praising those concepts very highly.

How do we reconcile this kind of an attitude?

Dr. MCTAGUE. I don't think—with respect to the latter first, it certainly isn't a matter of attempting to take credit on the part of the administration for an idea which I think all of us support. I don't think credit is a conserved variable first because one person receives credit for something doesn't mean that another person or entity is not equally worthy of that.

We had differences on the mechanism of how to approach this goal of multidisciplinary centers as opposed to what the goal actually was.

With respect to how we arrive at decisions, I think the National Aerospace plane provides an interesting example. Within the Office of Science and Technology Policy, we have established a broadly based Aeronautical Policy Review Committee which consists of members from many of the aerospace industry—senior level people, vice president level, et cetera—and representatives of NASA, and of the various Defense Department agencies, who have been looking at what our posture should be as a nation over the

long haul in the aeronautics area, an area in which we have maintained preeminence since the Wright brothers, and which, in addition to contributing in an essential way to our national defense and to our conquest of space, has provided the industry which is at the moment, I believe, the greatest positive contributor to our balance-of-payments problem.

This distinguised group made a series of recommendations for support of short, term intermediate term, and long term technologies, one of which was indeed this plane. That recommendation was made to us over a year ago. We have heeded it. This comes in confluence with a larger amount of basic research in multidisciplinary areas that has been done by DARPA over several years in advancing materials, technology, and also in NASA, in advancing our understanding of hydrodynamics and advancing our capability to computer model advanced aircraft, and in advancing the technology of ramjets and scramjets.

And it is this confluence of all of these multiple basic research activities and at the same time a policy assessment made by the broadest possible set of constituents, I believe, that has led us—and more importantly, led the President to recommend this as an important and urgent national goal.

Mr. BROWN [presiding]. We understand the fortuitous confluence of interest in something like this, because it represents the national security interest as well as the national economic or commercial competitiveness interest. We don't have that same confluence in other areas. We have different sets of circumstances.

But you would agree, I am sure, that the security of the United States is enhanced by our continued scientific, technological and trade leadership, and that we need to do it—to take action to preserve that.

Dr. MCTAGUE. Absolutely.

Mr. BROWN. But one of the unfortunate things about the Soviet system which is driven to put their resources largely into defense R&D, is that, in the words of Administrator Casey of the CIA, they are a basket case economically now. And we don't want to see the United States become a basket case.

You don't see any possibility that we are modeling ourselves too closely after the Soviet system, do you?

Dr. MCTAGUE. Gosh, I hope not. [Laughter.]

Mr. BROWN. Well, there are some very interesting coincidences here, and the amount of our R&D that is being driven by strictly defense needs.

Dr. MCTAGUE. There are several crucial differences between the Soviet system and the American system. I don't believe that the major problem in the Soviet Union is in fact their large investments in defense R&D, but it is the fact that they compartmentalize their approaches to research and development as they compartmentalize almost every other one of their activities. As a result of this high level of secrecy, they don't get multiple benefits of a particular piece of research and development, many of which they create several times even in their defense area. It hobbles them from using computers because they fear the spread of information through computers.

Our system of freedom is a remarkable one, and in fact, we get enormous multiple payoffs, one of which is this particular aircraft, from defense investments in research.

Mr. BROWN. Well, Dr. McTague, I would just comment that the thrust of this administration is also in the direction of compartmentalization and the reduction in the free flow of scientific information. I don't think it is serious at this point, although it is moving in that direction. And we may be up against the same problems the Soviets face there also, in terms of the development of cutting edge technologies.

Dr. MCTAGUE. May I comment on that?

Mr. BROWN. Sure. [Laughter.]

Dr. MCTAGUE. It is certainly not the policy of this administration and personally not the policy of this President to increase, but to decrease the access to scientific information. And, in fact, on September 27th of 1985, the President issued a national security decision directive in which he stated quite clearly that it is our policy to have the freest possible communication of the results of fundamental research and directed all departments to make sure of that, and that if research is not classified, that no agency can place a restriction on dissemination, or conduct, or reporting of research related to fundamental science and engineering.

It is a clear and unambiguous statement made by the President himself.

Mr. BROWN. We will continue this debate later. I want to let my colleagues participate here.

Mr. Monson.

[No response.]

Mr. BROWN. Has he left?

Mr. Lewis.

[No response.]

Mr. BROWN. Mr. Gordon.

Mr. GORDON. Let me just quickly ask Dr. McTague, in your statement you say the President in a 1985 agreement with Congress for 3 percent real growth in Defense budget for fiscal year 1985.

I realize that when you look at a budget you can look at authorization and outlay, and many different aspects of it. But my figures indicate that the increase is from $286.1 billion to $320.3 billion would be more in the line of an 8-percent increase. In addition to a 4-percent inflation, I assume it would be 12 percent.

What figures are you working with?

Dr. MCTAGUE. This is figures prerecission due to the Gramm-Rudman-Hollings Act as its effect on the 1986 budget.

Mr. GORDON. Well, do you think that's fair to use those figures?

Dr. MCTAGUE. Well, that was not on the basis on which the agreement was made.

Mr. GORDON. Oh, so you are saying that even though they have been cut, if the agreement was made before, even you know they have been cut, you are still going to use that original baseline?

Dr. MCTAGUE. That's the President's policy.

Mr. GORDON. And you're a company man, so you are going to continue to use those figures?

Dr. MCTAGUE. It's not that I'm a company man. I believe that the first responsibility of the Federal Government is to ensure the national security: the first and overwhelming responsibility.

Mr. GORDON. I agree with you. I think that's correct, and I think that the responsibility of Government officials is not to misrepresent the figures, and I think you can still try to obtain a strong national defense, as I would like to, without misrepresenting the figures. The concern I have is that it gives a lack of credibility in my eyes to the rest of the report when I see what I think is a misrepresentation here.

Dr. MCTAGUE. I don't believe that this was intended as a misrepresentation, and I don't believe it is a misrepresentation. It perhaps could have been stated with an extra sentence in there. But it is a three percent real growth over the pre-Gramm-Rudman-Hollings recission of 1986.

Mr. GORDON. And do you have those figures? Could you get those figures for me?

Dr. MCTAGUE. Yes, I can. I can get them for you. I do not have them here.

Mr. GORDON. OK. Thank you.

Dr. MCTAGUE. I only have the R&D figures here.

Mr. GORDON. Thank you.

[The information has not been submitted although several follow-up inquiries were made.]

Mr. BROWN. Mr. Valentine.

Mr. VALENTINE. Doctor, I think this is a kind of a upbeat report based on all of the doom and gloom that we hear from many sources. But do you believe that we can really continue to do what we need to do in this country in space exploration, and in encouraging, and in improvement of our national position in research and development, in all these other areas that we are talking about, without some additional revenue?

Dr. MCTAGUE. The budget that the President has proposed meets the Gramm-Rudman-Hollings criteria without any tax increases.

Mr. VALENTINE. Yes, I understand that. But are you willing to say that you really believe that? Do you think that we can continue to talk about—well, even the presentation to the Congress of a budget that I know, you say, well, Gramm-Rudman will take care of that—that's it so far out of balance, and does really continue to send the bill to our children and grandchildren, and then talk about a dedication to continuing our strong support for our Nation's science and technology, and the goals of enhanced national security.

Do you really believe in your heart that we can do all these things? What we are talking about here are programs that are really low down on the priority lists of many Americans. I have a lot of constituents that think we ought not to be involved in space exploration. I think they are dead wrong. But when we look at national priorities, how on Earth is it going to be possible for us to continue to do these things even in the basic, just to kind of keep our heads above water without some new revenue?

Dr. MCTAGUE. We are in tight times. It is incumbent on all of us to have the courage to make very difficult priority choices, which

in the short run may be very difficult and unpalatable, but in the long run are absolutely necessary for our children.

Mr. VALENTINE. Thank you, Mr. Chairman.

Mr. BROWN. Mr. Cobey.

Mr. COBEY. I don't have any questions, Mr. Chairman.

Mr. BROWN. Mr. Smith.

[No response.]

Mr. BROWN. Mrs. Schneider.

Mrs. SCHNEIDER. Thank you, Mr. Chairman.

Dr. McTague, I share with you the feeling that part of the overwhelming responsibility of the Federal Government is to provide for our national defense. And I would like to ask you to please articulate your philosophy as to the role of energy in the grand scheme of our national defense.

Dr. MCTAGUE. Of energy?

Mrs. SCHNEIDER. Energy. Nobody said this was going to be easy. [Laughter.]

Dr. MCTAGUE. Do you mean with respect to national security as a general issue or with respect to defense specifically?

Mrs. SCHNEIDER. What I am referring to is, what role does energy play in our overall future? And I will allow you to emphasize whatever aspects of that, be it national security and strategic, or also the impact on our economy, inflation, vis-a-vis our security.

Dr. MCTAGUE. There are obviously many things which impact on our national security, one of which—a major one of which, but only one of which is having a strong military force. Having a strong economy is also a very important portion of national security envisioned in the broadest sense.

The third one is having sufficient independence from dependence on resources which are supplied by areas of the world which may be interrupted for some reason at any time. From that point of view, it is certainly necessary that we have a sufficient energy base available to this country to meet national emergencies, and in addition to meet future energy needs 20, 30, 50 years out. That's one of the reasons why we do research in this area, to make sure that we have a multiple set of sources of energy. In particular right now we have a distribution within this country of commercial electric power sources based on nuclear power, based on oil-based plants, based on coal-burning plants in some modest amount at the moment on natural gas burning, but many of these plants can trade off between these resources. Flexibility is very important so that we are not held hostage by events that are not in our control.

Mrs. SCHNEIDER. Well, I think that your comments there completely reflect my own in terms of philosophical priorities of the three ingredients that are necessary in order to make sure that our country is secure.

However, you are just mentioning now the need for a multiple sources for our energy base reflects an emphasis on supply. You mention nothing, nor does the energy budget reflect any understanding whatsoever of the role of energy efficiency in terms of a strong economy, or strong national defense.

The budget that we are looking at here for the Department of Energy—this is just the non-defense budget that I would like to reflect upon.

The 1987 budget is more than 50 percent lower than 1985's budget. To me, that is devastating. And when one looks at the line items and can very rapidly see that many of the research and development programs for renewables, for energy efficiency, have essentially been zeroed out or reduced by 50 percent. I think that that does not fit your description of a good energy base or a balanced energy base.

If we look at some of the scientific and technological breakthroughs that have occurred in the past couple of years, they saved the American economy $150 billion a year. We have witnesses come before our committees here and testify to that effect. And there have been clear indications that if we were to continue our research investment in the advancements in solid state electronics, communications, materials research, that would have the opportunity to save another 150 to 250 billion per year.

Now, if we are talking about Gramm-Rudman, there is an enormous opportunity for us that has not been looked at or even though about from what I can tell in looking at the budget and also listening to your comments.

I think that if we recognize that we need the lead time, more often than not, when you say we are planning for the future, of sometimes 20 years or more to develop and commercialize some of these energy-saving technologies , I don't think that we can afford to abandon, in our Federal R&D budget, that commitment to energy sufficiency.

And then another dynamic that is critically important to me that has a lot to do with our deficit and our budget is the whole question of our export trade deficit. And when we look at those witnesses that come before our committee to testify to provide us with where our competitive edge is or is not, I believe, and I could be off on this, but I believe that we have lost our competitive edge in the energy technology field on somewhere around six out of the nine technologies.

And when you look at such things as the fuel efficient automobiles coming out of Germany or out of Japan, that's an obvious example. But we also have numerous other examples in heat reclaimers and a whole broad spectrum of things—photovoltaics, we are just on the edge there—but there are a number of technologies that we are essentially throwing to our competitors in the world market.

I think this is shortsighted. I would like to, you know, certainly have you reconsider that. And I'd also be interested in, Mr. Chairman, if I have another second, to see if Dr. McTague feels that my thinking, amplified by some of the facts that I have garnered over the last 5 years on this committee seem to be on target.

Dr. McTAGUE. Well, I think we have a few minor differences.

Mrs. SCHNEIDER. Such as?

Do you not see the value of energy efficiency as an important part of our energy mix?

Dr. McTAGUE. I think it's related to the push and pull of the marketplace. As the price of energy goes up, we will become more efficient because we have to, rather than because the government is arbitrarily driving us in that direction.

Mrs. SCHNEIDER. But that comment doesn't jibe with the comment you made a little while ago saying that we need to have long lead time in investments today to secure ourselves for tomorrow, nor does it jibe with the reflection of our investments, for example, in the synthetic fuels budget.

Dr. MCTAGUE. We are doing a long-term research. The question is: What do we do about driving the technologies as they get close to commercialization.

Mrs. SCHNEIDER. No; that's not the point at all. We are cutting by 50 percent that research budget.

Dr. MCTAGUE. Not in the basic research end.

Mrs. SCHNEIDER. In energy efficiency, the material that I have indicates that we are.

This committee has been very receptive to the philosophy of allowing us to move toward commercialization and development letting the private sector in the marketplace make those determinations.

But I think that insofar as some of the basic research is concerned in those efficiency technologies I don't see it reflected, but maybe I have overlooked it.

Mr. BROWN. The time of the gentlelady has expired.

Mr. Traficant.

Mr. TRAFICANT. Thank you, Mr. Chairman.

I see in the opening page, front page of your opening statement, you say, "Simply stated, Gramm-Rudman-Hollings lays out a schedule to wean us from the addiction of signing our children's names to IOU's for our own pocket money. This withdrawal process begins in a few weeks."

Evidently you see that for everybody else, which most of the President's men do on their own particular positions.

Second of all, on page 9, there is another interesting passage, sort of a dichotomy to me. "This calls for an increased Federal investment in higher education and for special attention to the maintenance of modern research facilities and instrumentation on our Nation's campuses—a call we intend to heed." I believe the President's budget doesn't, in fact, deal with that hardly at all—in fact, just the opposite.

My particular questions—I continue to pound, I guess, at this committee, perhaps having some people upset—is relative to page 6, where you say, "A principal observation of the President's Commission on Industrial Competitiveness was the value of encouraging stronger ties between government, universities, and industry, suggesting that their traditional aloofness was not in the best interest of the Nation. The transition from basic science to technology to product is occurring more and more rapidly, and will continue to accelerate in the future."

I think many people feel that the only significant major exchange has been to the defense industry of this country in the military pursuits.

Could you cite any examples of where that exchange and interchange has had a significant impact relative to product and commercial use? One.

Dr. MCTAGUE. The whole microelectronics industry was a result of DOD-based research to develop guidance systems from missiles.

The computer industry in the United States was driven almost entirely in its initial phases for research by investment by the Department of Defense to create products that it needed for its own purposes.

The commercial jet aircraft industry in the United States is in fact in large measure a spinoff from military research and development which has been done in conjunction and in close collaboration with the major aerospace companies, and who have utilized the fruits of this research, and have contributed to it themselves.

The biotechnology industries in the United States are a result of basic research funding across agencies, in particular the Department of Health and Human Services and the National Science Foundation, to mention a few.

Mr. TRAFICANT. Doctor, I think the point you mentioned show more of the zeal of the private sector to acquire new technology and to move forward rather than the interchange of what you allude to here in this statement. I think much of it has been ascertained, as you have alluded to the Department of Defense about three or four times there.

My next question is: How much of the SDI research and development do you expect to be performed by industrial firms and government laboratories in Japan or Western Europe, or any other foreign-based countries?

Dr. MCTAGUE. That will depend on their ability to compete for contracts. There is no set amount. There is a policy guidance by the President to encourage cooperation with our allies in these areas. There are certain areas in which other countries have technology bases that we could profit from.

On the other hand, our own technology base is exceedingly strong and I would expect that by far the majority of contracts will be let within the United States.

Mr. TRAFICANT. Thank God.

Dr. MCTAGUE. We are talking about defense of the whole west of the world and we must do it together.

Mr. TRAFICANT. Well, I think the defense element has been stated to everybody and every committee quite well. If we would have a conventional war we would suffer very greatly. I disagree with your defense position. I think the defense position of the President and his men is not in the best interest right now of the country, although I guess I am in a small minority, but I will tell you here.

Finally, you say on page 2 and in concert with the question asked by Mr. Gordon, when you talked about the 3 percent real growth of Defense budget year 1987, you say that: "This allows for continued modernization of our tactical and strategic forces, within a funding level which is still one-third smaller, as a fraction of GNP, than it was in 1960."

Now, I don't have any figures——

Dr. MCTAGUE. I do.

Mr. TRAFICANT [continuing]. To doubt you on that. I would ask that you would submit those figures and the data of which you compiled those figures with to the committee. I ask the chairman, that they be included in the testimony here.

Dr. MCTAGUE. I can tell you——

Mr. TRAFICANT. I ask unanimous consent.

Dr. MCTAGUE. I can tell you the number right now. Defense right now is 6 percent of gross national product. It was 9.3 percent in 1960.

Mr. TRAFICANT. Could you please, though, give us the basis of this statistical compilation involved so that perhaps we could see if we are comparing apples to apples and beans to beans. Sometimes we are a little confused with this.

Dr. MCTAGUE. Surely.

Mr. BROWN. Without objection, that will be included in the record.

[The information has not been submitted although several follow-up inquiries were made.]

Mr. BROWN. Mr. Morrison.

Mr. MORRISON. Thank you, Mr. Chairman.

Dr. McTague, I am interested in an agreement that seemed to come out of the Geneva conference between Mr. Gorbachev and the President on fusion. I wondered if from your vantage point you could tell the committee why that particular area was selected as I presume an example of our ability to work together in a technical arena.

Dr. MCTAGUE. I think there were two reasons underlying that, one of which is that it is in the interest of the world in general to create the technology base—to explore the technology base for a safe, cheap, renewable supply of energy that could address the world's needs into the indefinite future.

In the area of plasmaphysics and other sciences that are essential to the fusion activities, the Soviet Union and the United States are on a rough par. It's one of the few areas where there is a two-way street with respect to potential interchange of scientific information. Because of that the President directed the administration—the agencies—to pursue plans for multilateral, not just United States-Soviet, cooperation to advance the world's capability to have fusion energy, magnetic fusion energy to be specific, as a viable source of this renewable energy.

We are indeed consulting extensively with our European allies, with Japan, with Canada, and we solicit cooperation and involvement of any interested and qualified nation in the world in this endeavor to advance the science relevant to the advancement of fusion as a potential future energy source.

Mr. MORRISON. Let me make sure I understand. You say we really are in a rough equivalent with the Soviets as far as our scientific stance—standing?

Dr. MCTAGUE. Yes, sir.

Mr. MORRISON. In materials as well as in physics?

Dr. MCTAGUE. In the understanding of the relevant parameters, I would say, yes. In the areas of implementation and engineering, I would say the United States is substantially farther ahead than the Soviet Union, of course, also in computing capability, which plays a significant role if you are ever to talk about a demonstration project.

I am trying to distinguish science from building of a demonstration plant.

Mr. MORRISON. I guess I—the committee—the subcommittee that has some jurisdiction over this subject will have some concern because of our efforts through the years at international cooperation, and we have found some in some parts of the world. We are a little concerned that this agreement might end up actually hurting some of the progress we have made, particularly with the Japanese and Europeans.

You have commented on that, but anything further you can add—and I presume that you are involved in an effort to coordinate this agreement by the President—so we don't hurt the relationships we have with others and the investment they have made with us.

Dr. MCTAGUE. Yes, sir; I am quite heavily involved in this process. One of the ground rules that the President laid down for us was assuring multilateral cooperation in such an activity, and to make sure that we adhered to the so-called Cocom agreement rules with respect to technology transfer from Western nations to Warsaw Pact nations, that there would be no exceptions made for this particular area—and we intend to stick by that.

We will pursue activities that are mutually beneficial. We will not pursue activities which are a one-way street heading east.

Mr. MORRISON. I think that there probably will be some interest on additional hearings on this specific subject as we move on into 1986.

Thank you very much. Thank you, Mr. Chairman.

Mr. BROWN. Mr. Slaughter.

Mr. SLAUGHTER. No questions, thank you.

Mr. BARTON. Mr. Chairman, I have some questions.

Mr. BROWN. You are recognized.

Mr. BARTON. Dr. McTague, I have two simple questions. I am an engineer. I like your comments on what's been done on the engineering research centers that were set up last year and the additional plans for centers this year. I also represent Texas A&M, the Sea Grant College, and it is my understanding that the Sea Grant Program is to be discontinued.

Could you briefly comment on those two programs?

Dr. MCTAGUE. Yes, Congressman.

The Sea Grant Program has two distinct components to it, one of which funds generic research activities which the administration strongly supports. Unfortunately, linked to that inexorably by the statutes establishing the Sea Grant network is a set of local services and support activities which the administration does not believe are appropriate for Federal support as we do not in other agencies of the Government.

If we could somehow break that linkage, I think you would find very strong support for the research aspects of the Sea Grant College Program.

Mr. BARTON. What about the engineering centers?

Dr. MCTAGUE. The Engineering Research Center Program is something I will talk about forever if you want me to. I think it is an absolute gem. I hope we can get this model into more and more and more universities across the country, and not just in engineering. I think these linkages with industry, without industry dominating, person-to-person linkages are very good and could serve us

very well across other multidisciplinary fields like nonlinear mathematics, for example. We hope to expand in those areas.

Mr. BARTON. Thank you.

Mr. BROWN. Mr. Sensenbrenner.

Mr. SENSENBRENNER. No questions, Mr. Chairman.

Mr. BROWN. Mr. Walker.

Mr. WALKER. Thank you, Mr. Chairman.

If I can, just for a moment here before I head for the floor, deal with the question of the transatmospheric vehicle which I understand you got into before, but I want to just try to nail down a couple of points.

How quickly could we have this kind of a vehicle operating on a routine basis?

Dr. MCTAGUE. I mentioned that we are strongly technologically limited here in that, although the basic technologies all exist, some refinements are needed, and in particular, integration into a full vessel is a very delicate challenging problem.

The program that we are proposing is indeed limited by technology and not by funding—at least in the early stages. I don't believe that it is feasible to have a demonstration vehicle before the early to mid 1990's—let's say 1992 to 1995.

Mr. WALKER. That would be a prototype vehicle?

Dr. MCTAGUE. Yes, sir.

Mr. WALKER. And that's a vehicle with about a 5,000-pound payload, is that what we are talking about?

Dr. MCTAGUE. I am not sure of the exact payload number, but it wouldn't be done for payload purposes. An operational vessel then would be easily another 5 to 10 years off.

Mr. WALKER. So we are talking even if you accelerated the program, you are talking about operational vehicles might be possible. by the end of the 1990's?

Dr. MCTAGUE. Yes, sir.

Mr. WALKER. Could such vehicles—in the vision that you have put forward—serve as the second generation of space transportation vehicles?

Dr. MCTAGUE. Yes, it is one of the possibilities that is being looked at for that purpose by the National Commission on Space whose report will come to Congress in early April.

Mr. WALKER. I understand, but the technology itself is such that if we develop a transatmospheric vehicle we are probably capable of utilizing that as a second generation of shuttle. In addition to being able to fly the Orient Express, as the President talked about, you also have a vehicle that could—can be envisioned as a second generation space transportation system?

Dr. MCTAGUE. Yes, Congressman. I see that as one of the really great potentials of this technology.

Mr. WALKER. It becomes a dual-purpose vehicle?

Dr. MCTAGUE. Three-purpose vehicle. It has enormous potential impact on defense capabilities, being able to fly, pop up from any standard runway, which leads to a great degree of security anywhere in the world in a very short period of time, and with a payload. And also would be very, very difficult to counterattack.

So it has three sets of enormous potential payoffs.

Mr. WALKER. Thank you, Mr. Chairman.

Mr. BROWN. It travels faster than a missile, Mr. Walker.

Mr. WALKER. About time.

Mr. BROWN. Mr. Lujan.

Mr. LUJAN. Thank you, Mr. Chairman.

And let me show some enthusiasm for the Orient Express and would urge you—I am sure you are an enthusiastic supporter, but even more so, I think it's the thing that we ought to do, we ought to move in that direction. And the only thing that surprised me a little bit, you know, the mid, early 1990's are only 7, 8 years away. I would hope that we would be able to do it in that time.

I am sorry I was late. We had a meeting on the budget of the Nuclear Regulatory Commission, as all commissions are meeting these days, and that's why I was late. But the subject of concern at the moment is our whole space program, in view of the recent tragedy. Are we looking at, you know, what are we going to do to avoid the long delays? Have you had any discussions with NASA and how soon we can get up a shuttle launch?

Dr. MCTAGUE. We have an——

Mr. LUJAN. Six months, a year away, that's——

Dr. MCTAGUE. We have an ongoing interagency effort involving all agencies that are related, or are potentially related to both usage and of the shuttle, and of expendable launch vehicles, to examine our options carefully. We expect to have better information within the next several weeks.

Mr. LUJAN. Is there an accelerated effort along those lines since the accident?

Dr. MCTAGUE. Yes, sir. And in addition, of course, we are cooperating closely with NASA in the investigation of the causes and how fast we can remedy them, the causes of the tragedy of last week. We will move together as expeditiously as we possibly can without compromising safety.

Mr. LUJAN. Even before last week's accident, can you give us your personal feeling of the Air Force's position of having backup ELV's? And along with that perhaps do you see a change of what you might have thought before and now in view of the loss of a quarter of our fleet?

Dr. MCTAGUE. The Air Force has consistently advocated having alternative possibilities for launch. Specifically envisioning that it was possible that for some reason a shuttle would not be available for some extended period, they do have the capability for launching some of their satellites with existing missiles. They have a procurement process for getting heavier launch capability in a few years.

Mr. LUJAN. I was thinking mostly of the position of OSTP in this whole argument between the two.

Dr. MCTAGUE. We have consistently advocated multiple paths for launch capability, but while also reaffirming the President's and the Department of Defense's decision, that the shuttle will be the major launch capability for the Air Force.

Mr. LUJAN. Along those lines, what do you think now the opportunities for commercial ELV companies and, you know, the position we find ourselves?

Dr. MCTAGUE. That is one of the options we are trying to examine carefully right now. Of course, in the very short term, they don't have any more capability than anyone else does because they

don't have the existing rockets to handle the launch. But this is probably a good time to examine from fundamentals what should be the role in particular of NASA. Should NASA shift more substantially toward emphasizing the research end or should it continue to be a supplier to all of even relatively standard transportation capability?

That's one of the things that is under close examination right now in cooperation with NASA and several other agencies, including the Department of Commerce and the Department of Transportation.

Mr. LUJAN. Are we in full committee?

Mr. BROWN. We are in full committee.

Mr. LUJAN. Then an energy question is in order.

Mr. BROWN. Go ahead.

Mr. LUJAN. The nuclear budget has been cut dramatically. Did you address that? I'm sorry, and if you did we won't take up the committee's time.

Dr. MCTAGUE. No; I didn't directly address that. The nuclear budget for 1987 of $377.4 million is down 12 percent. It involves a cutback in advanced reactor R&D, a shift in emphasis.

Mr. LUJAN. Are you talking about HTJR and those kinds of things?

Dr. MCTAGUE. Yes, sir.

Mr. LUJAN. A reduction—substantial reduction?

Dr. MCTAGUE. Yes, sir.

Mr. LUJAN. You got some dollar figures there or off the cuff?

Dr. MCTAGUE. I don't have them broken down for the particular components. But one of the important things is that we have got to do a better job of laying out, I believe, what are our priorities with respect to light water reactors, HTJR, et cetera, before we just keep spending money in several directions at once. I think an important part of that is getting a new Assistant Secretary for nuclear energy.

Mr. LUJAN. Yes.

Is fusion down quite a little bit?

Dr. MCTAGUE. Fusion is down from about $360 million to $330 million. The intent there is to focus more on the long range physics base and on the territorial configurations, to learn results that will be applicable in the decades out when these technologies will become closer to commercialization. Doing heavy engineering at this stage creates technology that you are certain will be obsolete when you actually want to make a power reactor.

So what we are trying to do is emphasize more those things which will carry over to the future.

Mr. LUJAN. Yes.

We have had some discussions on that you remember, and that's one of the things that I've been concerned about in that we get tied in too much to one area that—and as I explained before, you know, it's worth even shooting the dice to see if there's some other device that—a $50 million shooting of the dice is quite expensive, but not in terms of over the years and in our whole budget. So from that standpoint I am very happy to see it.

Thank you, Mr. Chairman.

Mr. BROWN. Dr. McTague, just following on in one of the areas that Mr. Lujan brought up, we are going to have to look at the question of balancing programs here and the question of whether to go with a fourth orbiter, or possibly to accelerate the space plane is one of those kinds of issues.

It's premature, of course, to speculate about it right now. But I know that the Congress would appreciate some opportunity to be involved in this kind of discussion.

But there's also another aspect which does not come within the purview of this committee and it illustrates part of our problem in developing policy here. We are deeply involved in a stealth technology development, which is going to produce a plane which is supposedly stealthy, at about $250 million a copy, or $40 billion for a fleet of them, which would be completely supplanted by this vehicle when it's ready for production—assuming it meets the goals that you have laid out so eloquently this morning.

The question arises—and the timeframe isn't all that different, the Stealth isn't going to be—the full Stealth fleet will not be available much before the year 2000. Is the administration giving thought in this broader kind of a perspective to the possible savings from moving to the development of the aerospace plane and soft pedaling the Stealth, which is going to be filled with bugs anyway, as I am sure you know. So far, the position of the administration, which the Congress has supported, is run out the B-52's, put on the B1B, and go with the Stealth—in a sense creating an overlapping and duplicative program in some ways, but making sure there's no gaps here in our defense posture as it involves this leg of the triad.

It seems to me that this is an important policy issue with huge fiscal implications.

Dr. MCTAGUE. Yes, sir.

Mr. BROWN. My question is not to indicate thinking in one way or another, but are we looking at this possibility, or can we undertake an effort to look at it?

Dr. MCTAGUE. Yes, sir; we are looking at this. There are obviously many facets of this that we can't talk about here. But suffice it to say for now that many aspects of the Stealth Program address different scenarios than do those potentially addressable by the aerospace plane. They involve different flight regimes, they involve different costs, probably, of acquisition of a vehicle, and of maintenance, different state of the art. But the overall issue that you speak about is indeed being addressed and in particular we in our office spend a lot of time thinking about, and making recommendations, and coordinating such activities.

Mr. BROWN. Well, I don't want to go into any of the highly classified aspects of this.

It seems to me that if this plane develops as its been presented to us in the briefing, it's inherently a stealthy technology or its a survivable technology.

Dr. MCTAGUE. Not stealthy, but probably highly survivable because of its altitude and speed.

Mr. BROWN. Well, what is the difference? The purpose of Stealth is to procreate survivability.

Dr. MCTAGUE. You can see that's one of the differences. And their range aspects are different. I think that's about as far as I want to get into that.

Mr. BROWN. All right.

Let me deal with another subject. Over the years, the last 15 years or so, its been clear that the DOD and the Air Force in particular was not enthusiastic about the man in space. That they really, until fairly recently, didn't see a solid reason to support the shuttle. That is changed slightly. But I think, fundamentally, they haven't changed their idea too much about the significance of the civilian space program as a contributor to the defense mission as we have configured the civilian program.

Now, if this becomes an element in the civilian program, it seems quite clear that this is going to radically revise the attitude of the DOD about military man in space, and significance of that role.

Dr. MCTAGUE. Yes, sir.

Mr. BROWN. In other words, they will be enthusiastic in support of this because they see a very clear defense mission for it.

Dr. MCTAGUE. Yes, sir.

What you are dealing with here is a difference between a craft which could have some of the characteristics of an attack or defense superplane as opposed to a merely—or just the other aspect which is a transport vehicle for getting something up into space. So it's an expansion of the realm of possibilities. In one you clearly need a man and in the other one there are some activities for which you do and some for which you don't.

Mr. BROWN. Well, I welcome that. Very honestly, as you know, I'm not the most enthusiastic supporter of putting the military in space. But I welcome a unified approach to the significance of a manned program in space, and I think it will make our job easier in many ways in developing a national space program and space infrastructure.

I have some similar feelings about some other aspects of space. For example, we are busting our fanny to develop power sources in space. Again, it didn't seem to be a very high priority deal for the kinds of things that the civilian space program encountered. Now, obviously, the military, as we get closer to decisions about SDI, is going to want a lot of power up in space. It seems to be that this is a multipurpose kind of a program again—that we can develop a substantial power program in space that has civilian and military, and it's up to the policymakers—the President and the Congress—to decide how we use this capability. That capability——

Dr. MCTAGUE. Yes, sir.

Mr. BROWN [continuing]. Power in space and—and a lot of other capabilities in space.

Am I on the right track there?

Dr. MCTAGUE. Absolutely; in fact, we are accelerating our efforts within the nuclear program in the Department of Energy for such capability.

Mr. BROWN. All right.

Mr. Lujan.

Mr. LUJAN. I've got a couple of really quickies—two concerns. One is the national laboratories.

Dr. McTAGUE. Yes, sir.

Mr. LUJAN. I recognize and support the fact that the primary mission of our national laboratories is defense-oriented, and that nothing should detract from that. However, with the reduction in energy research and those kinds of things, it bothers me that we might get back to the same place that we were years ago before we started the big energy research, and that is not utilizing all of the advantages that we have in those national laboratories for some civilian programs. I just want to make the point that I think it is very necessary to utilize those capabilities in other things and that is how it gets on in the private sector.

The second point—we have had many, many discussions in the committee about research funding of universities. The concern that the rich get richer, you know, the concentrating, the—I can't remember the figures now—of a third of all of the—well, certainly a half of that in 20 universities throughout the country. And our we understand that you have got the best research that you can for the buck, but the other side of it is that we can spread out that excellence throughout other universities as well.

Dr. McTAGUE. I—there's no question that we spend the lion's share of our individual research support funds on the best talent we can find regardless of where it is, although to some extent we do, in fact, when there is a marginal decision, et cetera, we do take into account geographical and other distributions, and we do have special programs for certain activities.

We believe that this is the most prudent thing for the Federal Government to do. It is the responsibility of individual institutions and States, in my opinion, to make the conditions attractive to The very best talent they possibly can. If a university has doubled the teaching load and half the salary of a institution in another State, you can bet where the best research is going to go.

Mr. LUJAN. I understand that. If we were a private company whose aim is to get results from that particular experiment Mr. McTague. Yeah, that argument very good. We are, however, a governmental unit whose responsibility includes upgrading our expertise in the whole country. I'm not argu——

Dr. McTAGUE. Absolutely.

Mr. LUJAN. You know, I'm not trying to pick an argument with you. I'm just saying that we have to be a little more cognizant of that fact, that that additional responsibility that we have in addition to getting the best research that we can get.

Dr. McTAGUE. I agree with you, Congressman, but I believe that the major portion of the responsibility for developing local talent lies in other than the hands of the Federal Government. We do have a clear responsibility in the general science and engineering education area to make sure that all of our youth have equal opportunity to excel in these fields.

Mr. LUJAN. There's a big concern, I will tell you very honestly, in the Congress, in the committee, about that distribution. I think it ought to be looked at—looked at very carefully, because just like what happened in facilities—you know, they refer to it as poor, because we put in money for an engineering building here and there.

If we don't try to equalize—maybe not equalize, but take into consideration this additional responsibility because of those other

universities, you will find, and I hear some rumblings of saying, all right, 15 percent of our research budget, you must take geographics into consideration, or things like that. That's beginning to build up a little bit amongst the Members of the—of the Congress.

Do we approach that by making specific appropriations to facilities in different places, bypassing the whole peer review system? You know, if we are not very careful, we are going to be getting those kinds of amendments as we go forth.

Mr. BROWN. Just to supplement what Mr. Lujan has said, I'm sure you see the immediate parallel between the Nation's first major research program and the way it was established, and that's agricultural research. It basically, because of the factors that Mr. Lujan has mentioned, was set up to be distributed on a formula grant basis rather than a basis of excellence. That's still the case, and it's one of the weaknesses, I might say, of the agricultural research and even the extension system, that the funds are distributed in an effort to secure geographic equity.

While there is merit in this approach to a degree, the real needs of this country is to establish a system which meets both the need for excellence and the need for equity.

Dr. MCTAGUE. Yes, sir.

Mr. BROWN. How you get that is not always very easy.

Dr. McTague, we will not further harass you this morning. You have done a very good job; a worthy successor to Dr. Keyworth who lasted 5 years under these circumstances. We hope you are able to do as well.

Dr. MCTAGUE. Thank you, Congressman. [Laughter.]

Mr. BROWN. The committee will be adjourned.

Mr. LUJAN. Thank you.

Dr. MCTAGUE. Thank you.

[Whereupon, at 11:25 a.m., the committee was adjourned.]

○